

2071

RUBBER RESEARCH INSTITUTE

OF

MALAYA.



ANNUAL REPORT, 1930.



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THE RUBBER RESEARCH INSTITUTE OF MALAYA INC.

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JULY, 1931.

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ANNUAL REPORT OF THE BOARD.

FOR THE YEAR ENDED 31st DECEMBER 1930.

The Rubber Research Institute of Malaya having come into existence on the 1st September 1925, by virtue of the Incorporating Enactment No. 8 of 1925, the year 1930 therefore constitutes the fifth year of the Institute's existence. As however the active operations of the Institute can only be said to date from the appointment of a Director in September 1926, the year under review constitutes only the fourth completed year of active operation.

2. BOARD MEMBERSHIP.

The following changes in the personnel of the Board took place during the year :—

- (a) Mr. E. N. T. Cummins, one of the two representatives of the Planters' Association of Malaya went on long leave on the 1st April and returned and resumed his seat on the 26th December. During his absence Mr. R. S. Chantler was appointed to act as his substitute.
- (b) During December 1929 The Rubber Producers' Association of Malaya Inc., having ceased to be operative, surrendered its privilege to nominate a Member of the Board. In the meantime steps have not been taken to fill this vacancy.
- (c) The Hon. Mr. H. G. R. Leonard, Treasurer, Federated Malay States, who sat on the Board as the Financial Adviser nominated by the High Commissioner, Federated Malay States, was transferred from Kuala Lumpur in March 1930. His successor in office, the Hon. Mr. G. P. Bradney, became a member in his stead.

The final composition of the Board at the end of the year was as follows :—

- (a) President and Chairman—Dr. H. A. Tempany, Director of Agriculture S.S. & F.M.S.
- (b) Member nominated by the High Commissioner to represent the interests of small-holders—Che' Hamzah bin Abdullah.
- (c) Member nominated by the High Commissioner to represent the States of Johore, Kedah, Perlis, Kelantan and Trengganu—The Secretary to High Commissioner (J. D. Hall Esq.)

- (d) Members appointed by The Rubber Growers' Association—
The Hon. Mr. J. S. Arter and C. B. Graburn Esq.
- (e) Members appointed by The Planters' Association of
Malaya—The Hon. Mr. H. B. Egmont Hake and E. N.
T. Cummins Esq.
- (f) Member appointed by The Asiatic Planters' Association of
Malaya—K. Arumugam Esq.
- (g) Financial Adviser nominated by the High Commissioner.
The Treasurer, Federated Malay States (The Hon. Mr.
G. P. Bradney).

3. BOARD AND COMMITTEE MEETINGS.

During the year 37 Meetings of the Board and of its Committees were held as follows :—

Ordinary Meetings of the Board	...	5
Executive Committee	...	12
Finance Committee	...	13
Experiment Station Committee	...	7
		—
		37
		—

4. ACCOUNTS.

The accounts for the year ended 31st December 1930 as passed by the Auditors of the Institute are printed as an Appendix to this Report. The accounts have already been published in the F.M.S. Government Gazette. (Vol. XXIII No. 7).

5. INCOME.

The following statement shows the contributions received from the various Contributing Administrations during each year of the Institute's existence up to the 31st December 1930 :—

	F. M. S.	S. S.	Johore	Kedah	Kelan- tan	Tren- gganu	Total for year
Income prior to Incorporation, i.e. to 1st Sept. 1925	\$ 130,664	32,805	37,500	15,750		1,648	218,367
1925 (1st Sept. to 31st Dec.) ...	81,020	14,580	16,668	7,000		608	119,876
1926 ...	269,145	60,705	50,000	21,000	7,837	2,881	411,568
1927 ...	214,371	48,540	50,000	21,000	9,837	3,002	346,750
1928 ...	293,079	65,942	50,000	21,000	9,603	2,820	442,444
1929 ...	437,495	95,000	50,000	21,000	13,733	3,714	620,942
1930 ...	419,420	76,591	50,000	46,386	11,972	2,649*	607,018
Total Income to 31st Dec. 1930 ...	\$1,845,194	394,163	304,168	153,136	52,982	17,322	2,766,965
Percentages ...	66.68	14.24	10.99	5.55	1.92	0.62	100

* Contribution for Fourth Quarter not included.

6. CAPITAL AND RECURRENT EXPENDITURE.

The following table shows the Capital and Recurrent Expenditure in each year up to the end of 1930 :—

		Capital Expenditure.	Recurrent Expenditure.
		\$	\$
1925	...	28,565	3,431
1926	...	172,673	54,934
1927	...	381,330	276,712
1928. Institute	...	159,820	
Experiment Station		47,752	396,341
1929. Institute	...	23,734	
Experiment Station		293,968	461,622
1930. Institute	...	45,085	
Experiment Station		105,437	512,828

12,579,44

As was explained in last year's report the apportionment of the expenditure incurred in the development of the Experiment Station at Sungei Buloh had been only tentatively made. During the year under review the tentative apportionment was confirmed and the figures given above are therefore on this basis of apportionment.

7. PROVIDENT FUND.

The Statement of Accounts and the Report for the year 1930 disclose that the sound position of the fund had been maintained and had improved. The distribution of income for the first-half of the year was 3.1% and for the second-half 3.73%, making a total distribution of 6.83% which may be considered highly satisfactory.

A new rule was added during the year enabling members to make additional contributions or deposits with the Trustees. This new rule has already been taken advantage of in one instance.

8. CONSTITUTION.

During the year the Board has had under consideration the question of making certain alterations in its constitution in consequence of the vacancy created by the surrender of its privilege by the Rubber Producers' Association of Malaya Inc. No definite decision had however been arrived at by the end of the year.

9. RUBBER ROADWAYS COMMITTEE.

A Committee has been formed to investigate the possibilities of the use of latex in roadways surfacing. The personnel of the Committee is as follows:—

Dr. H. A. Tempany (Chairman).

Hon. Mr. H. B. Egmont Hake.

E. N. T. Cummins Esq.

H. T. Nicholas Esq., Deputy Director, Public Works Dept.
F.M.S.

Major B. J. Eaton.

The Government has approved the grant of a sum of \$150,000 for the purpose of these investigations out of the Rubber Experimental, Research and Propaganda Reserve Fund. The Board of the Institute has also decided to allocate a sum of \$50,000 out of its general revenue for the same purpose.

10. QUARTERLY JOURNAL.

Modifications were decided on during the year in the method of publishing this journal. Hitherto it has been a quarterly publi-

cation. In 1931 and after it will be published as and when sufficient material warrants publication and general articles which are not the result of research work carried out by the Institute will in future be contributed to the Malayan Agricultural Journal instead of appearing in the Institute's Journal.

11. NEW PERMANENT LABORATORIES.

The question of a site for and the erection of new permanent laboratories has not been taken up actively during the year. The matter is however being kept in view by the Board.

12. LONDON ADVISORY COMMITTEE.

The advice and facilities available to the Institute by means of the London Advisory Committee have been made use of during the year and acknowledgment is made of the services rendered by this Committee to the Institute.

13. DIRECTORSHIP OF THE INSTITUTE.

At the December meeting of the Board it was decided to appoint Major B. J. Eaton, O.B.E., F.I.C., F.L.R.I., F.C.S., as substantive Director of the Institute with effect from the 1st November 1930 until the termination of his period of secondment from the Government Service, namely 31st October 1932, thus confirming him in the position which he had held in an acting capacity for slightly over 12 months.

14. HEADS OF DIVISIONS.

Satisfactory progress has been made in relation to the appointment of substantive Heads of Divisions.

On the appointment of Major B. J. Eaton to the Directorship, Mr. R. O. Bishop was appointed substantive Head of the Chemical Division.

The Government approved the secondment to the Institute for three years of Mr. A. Sharples, Mycologist, Department of Agriculture S.S. and F.M.S., and on his return from leave he will assume duty as Head of the Pathological Division.

Up to the end of the year the post of Head of the Botanical Division had not been filled.

H. A. TEMPANY,

President and Chairman 1930.

May, 1931.

ANNUAL REPORT 1930.

BY

THE DIRECTOR.

Introduction.

Considerable progress has been made during the fourth complete year of the Institute's existence, in spite of difficulties caused by shortage of staff.

Throughout the year the substantive appointments of Heads of the Botanical, Chemical and Pathological Divisions have remained vacant, while the Head of the Soils Division proceeded on service leave during May. Correspondence and Advisory Work have again shown considerable increases compared with the previous year and have consequently interfered with the progress of research in many directions.

In relation to the applications of research to immediate practical problems, however, a number of useful investigations have been undertaken and carried to a sufficient stage to enable results to be published or otherwise disseminated.

Staff.

The writer continued to act as Director until the 1st November when on the recommendation of the London Advisory Committee he was confirmed in the appointment by the Board.

BOTANICAL DIVISION

The post of Head of the Botanical Division was advertised but no suitably qualified candidate was available.

The work of the Division has been shared between Mr. L. E. Morris (Geneticist) and Mr. C. E. T. Mann (Plant Physiologist) under the general supervision of the Director.

The Board decided, in view of the large amount of work to be done, especially in connection with the extension of budding, to appoint a Junior Botanist. Mr. C. C. T. Sharp was selected by the London Advisory Committee for this appointment and will assume duty early in 1931.

Mr. H. Gunnery, Technician, attached to the Botanical Division was on leave from the 3rd January until the 22nd August.

Mr. K. N. Kaimal, Assistant Botanist was on special leave from 7th February till 7th April.

PATHOLOGICAL DIVISION

Mr. A. R. Sanderson continued to act as Head of the Pathological Division but is due to retire on reaching the age limit early in 1931. Mr. A. Sharples, A.R.C.S., D.I.C., Mycologist, of the Department of Agriculture, S.S. & F.M.S., was offered and accepted the appointment of Head of the Division and the Government on the recommendation of the Director of Agriculture, S.S. & F.M.S., agreed to his secondment for three years, with effect from his return from long leave. Mr. Sharples will assume duties early in 1931.

It is with great regret that I have to report the death of Mr. H. Sutcliffe, A.R.C.S., F.L.S., Pathologist, which took place on the 26th November. Mr. Sutcliffe had rendered very conscientious service to the Institute, since his appointment on the 1st November 1926.

Owing to the prospective retirement in 1931 of Mr. A. R. Sanderson, the Board decided to appoint a new junior Pathologist. Mr. R. P. N. Napper was selected by the London Advisory Committee for the appointment and assumed duty on the 7th October.

Mr. F. Beeley, Field Officer, continued to be attached to the Division, but also carried out other duties in the Field Division.

CHEMICAL DIVISION

Mr. R. O. Bishop continued to act as Head of the Chemical Division and was confirmed in the appointment on the 1st November.

Dr. E. Rhodes, Biochemist, was attached to the Division throughout the year.

Mr. R. G. Fullerton proceeded on eight months' leave on the 15th November with a possible extension for study leave.

Mr. K. C. Sekar, Assistant Chemist, was on duty throughout the year.

SOILS DIVISION

Dr. W. B. Haines, Head of the Soils Division, proceeded on long leave on the 13th May for the remainder of the year.

Dr. C. F. Flint, Soils Chemist, was appointed to act as Head of the Division with effect from 13th May until the return of Dr. Haines.

Mr. C. G. Akhurst was selected by the London Advisory Committee as Soils Chemist and assumed duty on the 7th October.

Messrs. K. S. Pillai and T. S. Anantharama Iyer, Assistant Soils Chemists, were on duty throughout the year.

FIELD DIVISION

Mr. G. Davidson, Chief Field Officer, arrived and assumed duty on the 6th February.

Mr. F. Billington, Field Officer, continued to be attached to the Botanical Division for special field work in connection with experimental work on budding and tapping experiments on budded rubber.

Mr. N. C. Jenkins, Field Officer, continued to serve throughout the year in the State of Johore and was stationed at Johore Bahru.

Mr. F. Beeley remained attached to the Pathological Division in addition to carrying out work which falls within the sphere of the Field Division.

LIBRARY

Mrs. A. White was appointed Librarian and assumed duty on the 5th March, but resigned the appointment on the 25th May.

Miss A. McInerny was appointed Librarian in her place and assumed duty on the 27th May.

OFFICE

Mr. V. L. Cachemaille, Secretary, was on duty throughout the year.

EXPERIMENT STATION

Mr. H. W. Foston was on duty as Manager throughout the year, except for a period of about five weeks when, owing to illness, Mr. H. B. Wilkinson was engaged temporarily to act as Manager.

Mr. C. V. Cavendish was appointed as Assistant on the 3rd February, but his services were terminated on the 31st May.

The Board, on the recommendation of the Experiment Station Committee, appointed Mr. H. G. W. Mathews as his successor with effect from his return from leave early in 1931.

Mr. A. E. Ford was appointed to act temporarily as Assistant with effect from 1st June, until the return of Mr. Mathews.

Mr. D. S. Gardner continued as Visiting Agent throughout the year.

Co-operation and Liaison with other Organisations.

Cordial and valuable co-operation has continued to exist with the Department of Agriculture, S.S. & F.M.S., and the Co-operative

Societies Department, F.M.S. & S.S. in relation to work on behalf of small holders and in other directions.

The Director of the Institute has continued to be a member of the Advisory Committee of the Department of Agriculture S.S. & F.M.S., and of the Advisory Board of the Co-operative Societies Department F.M.S. & S.S., also of the Publications Committee and Agricultural Pests Supervising Committee of the Department of Agriculture, S.S. & F.M.S.

It has thus been possible to keep in close touch with all matters affecting agricultural practice generally in Malaya, which is a factor of considerable importance in relation to various fundamental problems.

Liaison has also been maintained with the Rubber Research Scheme, Ceylon, the Central Rubber Proefstation at Buitenzorg, Java, and the Algemeen Proefstation der A.V.R.O.S., Medan, Sumatra.

Considerable exchange of correspondence has taken place between this Institute and these organisations in relation to matters of technical interest, which has been of value to all concerned. This liaison has also been improved by a visit paid by the writer to Sumatra and by an exchange visit paid by the Director (Dr. d'Angremont) and the Agriculturist (Ir. J. F. Schmole) of the A.V.R.O.S. Proefstation to this Institute. A programme of visits to estates in Malaya was arranged for Dr. d'Angremont and Mr. Schmole who spent about a fortnight in Malaya.

A valuable and interesting programme of visits to estates in Sumatra was also arranged for the writer by Heer Blommendaal of the A.V.R.O.S. Proefstation, Sumatra, during a visit of about a fortnight in December 1929 and January 1930.

Special thanks are due to the Director of the A.V.R.O.S. Proefstation, to Dr. Heusser and Heer Blommendaal and also to the General Manager and the Director of Research of the Holland American Plantations, to the General Manager and scientific staff of the Goodyear Plantations, to the General Manager and to Dr. Arens (Director of Research) and the scientific staff of the Rubber Cultuur Maatschappij, Amsterdam, and to numerous estate managers in Sumatra for the hospitality and facilities afforded to the writer during his tour.

Mr. L. E. Morris (Geneticist) and Mr. N. C. Jenkins (Field Officer) also paid visits to various Research Stations and estates in Java during the course of local leave. Mr. C. E. T. Mann (Plant Physiologist) also visited Sumatra.

Close liaison has also been maintained between this Institute and the Research Association of British Rubber Manufacturers and I have to express my thanks to the Director of this Association for valuable co-operation in various technical matters.

FILM PROPAGANDA

The film propaganda van, which has been styled "Rural Lecture Caravan" was completed at the end of the year, but was not able to commence its first tour until 1931.

As stated in the Annual Report 1929, this van is run under the joint auspices of the Department of Agriculture, S.S. & F.M.S., the Co-operative Societies Department F.M.S. & S.S. and the Rubber Research Institute of Malaya for propaganda work primarily among small holders.

A joint Committee of the three organisations arranges the tours, while Malay Officers of the Department of Agriculture are appointed as lecturers and demonstrators for general agriculture and rubber. The lectures and exhibits on rubber are arranged by officers of the Institute. It is hoped to complete the construction of a trailer for exhibits in 1931.

It has also been considered desirable to use a lantern for lecture purposes; lantern slides in relation to rubber diseases etc., have been prepared.

LONDON ADVISORY COMMITTEE

No definite decision has yet been reached in relation to the inauguration of a joint London Advisory Committee for the Rubber Research Institute of Malaya and the Rubber Research Scheme Ceylon.

Advisory Work.

The advisory work on behalf of estates, in respect of correspondence, interviews and visits to estates has again shown an increase compared with the previous year.

Although, as was stated in the previous Annual Report, this has interfered considerably with research programmes, it indicates the value placed on the work of the Institute by the planting community and also keeps the research and field staff of the Institute in very close touch with practical problems on estates.

This applies not only to many problems which have arisen in relation to the recent development and extension of budding operations, but also to problems relating to manuring, soil conservation, diseases, replanting of old rubber areas, and to methods of preparation of raw rubber.

The extension of budding operations during the year has shown no sign of abatement, but manurial and soil conservation treatments have received a check, owing to the slump conditions.

During the year 5993 letters have been received which include 3373 letters dealing with planting problems. This exceeds the number received during the previous year.

The principal matters of interest dealt with in this connection are indicated in the following summary of enquiries on which advice has been given.

Budding	...	430
Manuring, Soil Conservation and Drainage	...	319
Soil Examinations	...	151
Diseases	...	494
Preparation of, or defects in raw rubber	...	573
Total		1,967

A detailed summary of all the technical problems on which advisory letters have been despatched to estates, agency houses and individuals is given as an appendix to this report.

The principal activities of the different Divisions of the Institute are summarised below, with observations on matters of special interest in relation thereto.

Soil Investigations, Soil Conservation and Manuring.

During the greater part of the year, only one European Officer (Dr. Flint) was available in the Soils Division.

As indicated in the report of this Division, there has been a decrease of interest taken in manuring on account of the present uneconomic position of the plantation rubber industry and several valuable experiments initiated on estates at their own cost have had to be abandoned.

A number of valuable experiments, however, are still in progress and a paper will be published shortly summarising our information to-date in relation to problems of manuring of the rubber tree.

In most cases, manuring has resulted in improvement in vegetative vigour and growth, especially in increase and improvement of foliage, but results in respect of increased yields of crop (latex) are frequently delayed.

The manuring of young rubber trees with small doses of fertilizers is also receiving attention.

The Imperial Chemical Industries are also taking a great interest in manuring problems and this organisation has laid down a series of experiments on various rubber estates, which will be watched with interest by this Institute. Another local fertilizer Company (Malayan Fertilizers Ltd.) is also interested in similar work. The co-operation of these firms with the Soils Division

of the Institute will be of value, since the records of properly laid out field experiments will be available.

Two other large rubber planting companies have engaged scientific officers for work in relation to soil investigations and improvement of planting material who are working in close co-operation with the staff of the Institute.

SOIL CONSERVATION

Methods of soil conservation are being adopted and extended by all estates which have sufficient funds for carrying on this important work, the value of which is now recognised.

A report issued by the Malaria Advisory Board, in consultation with the Soils Division of this Institute and the Department of Agriculture indicates that there is no incompatibility between the requirements of good husbandry and health in so far as the breeding of mosquitoes is concerned.

It is realised that any system of contour drains or pits on hilly or undulating land, in which rain-water accumulates for any period, instead of percolating through the soil, indicates that the system is not functioning properly.

It is also realised that terracing on steep slopes combined with bunding or the construction of bunds by means of earth dug from pits is preferable to the so-called silt-pit system, since the rain-fall is distributed over and percolates through a much larger area and is thus more available for the needs of the rubber tree.

Silt-pits should be considered primarily only as a source of earth for the construction of bunds.

COVER CROPS

It is recognised that cover crops on hilly or undulating land are also the first line of defence to any mechanical method of prevention of soil erosion. Results obtained from experimental plots at the Institute Experiment Station, which will be published shortly, show that cover crops definitely retard growth of rubber trees in the early stages, as was generally considered to be the case. This retardation, however, is at the expense of the soil which deteriorates more rapidly due to loss of humus by oxidation and leaching and we are convinced that in the long run, the growth of cover crops, when virgin jungle land is opened for planting, is essential.

It is of particular interest to note that the effect of cover crops is least in the case of basket planting of rubber seedlings, probably due to the better root development of such seedlings which receive no shock due to root pruning when planted in the field.

The problem of the most suitable types of cover crop, whether low growing or bushy or a combination of both still requires investigation.

No definite results are yet available from the experimental plots at the Institute Experiment Station.

It has been definitely proved, however, that *Dolichos Hosei* (*Vigna oligosperma*) is not a satisfactory cover crop on light soils, especially if prolonged dry weather is experienced, while *Centrosema pubescens* and *Calopogonium mucunoides* are very satisfactory and will withstand dry periods.

In relation to cover crops and the protection and conservation of the soil, for the cultivation of permanent crops such as rubber, attention is also being directed to methods which might be described as "forest" methods, in which selected weeds, and secondary growths are allowed to remain on the land or are encouraged to develop.

Very interesting results are being obtained on an estate in Pahang and the experiment is being watched with interest. Similar methods are being experimented with at the Institute Experiment Station.

SOIL BACTERIOLOGY

The investigations of the Bacteriologist indicate that the usual conventional methods of bacterial counts on the soils investigated, are not of much value for determining fertility.

A biological method of determining fertility and manurial requirements based on the evolution of carbon dioxide (carbonic acid) shows promise of proving useful and a paper on this subject will be published in the Institute's Journal during 1931.

ACCESSORY MINERALS

Investigations on the value and importance of small quantities of certain "accessory" minerals in soils are being carried out and as is stated in the Report of the Soils Division the influence of zinc compounds on the growth of leguminous cover crops is indicated.

Botanical Investigations.

Although work was handicapped owing to the absence of a Head of Division, considerable progress can again be recorded.

BUDDING

The planting of budded rubber during the year has continued to extend and the services and advice of Mr. C. E. T. Mann, Plant Physiologist of the Botanical Division, have been in great demand.

Owing to the unusual and prolonged drought following the normal dry period of the wintering season, budding operations during the short rainy season—April-May—were not so successful as usual, while later for the same reason, numerous reports of minor leaf diseases were recorded.

The extent of budding is again indicated by the amount of budwood imported. These importations show a decrease compared with 1929 but it is known that this is due to the amount of such material now available in Malaya from multiplication nurseries already established. In addition a considerable amount of budding from promising Malayan clones, the tapping records of which cover a shorter period than those of the best known Java and Sumatra clones, has been carried out.

The clone trial plot at the Experiment Station has been repeated under the control of the Institute on a replanted area on an estate. This experiment should prove very valuable in providing information on the important problem of re-planting old areas which are rapidly becoming wasting assets on account of root disease in the old trees. A number of estates have also carried out re-planting programmes, mostly on a small scale. In due course much valuable information will be obtained from these areas.

Records of yields have been continued on a large number of high yielding mother trees on various estates throughout Malaya and buddings for the establishment of clones from these trees at the Experiment Station have already been made.

Tapping experiments have been continued on the Pilmoor Estate clones, the best of which still maintain their yields.

In addition tapping records have been kept of several other promising clones established on different estates. These records have been freely supplied to the Institute by the estates concerned and the tapping of some of these clones is being continued under the direction of the Institute. The records indicate the existence of three or four very promising new Malayan clones.

Numerous enquiries concerning details of technique and various difficulties in relation to budding operations have been received and dealt with during the year. Many enquiries have also been received for advice on the most suitable clones for planting.

On one or two areas, budding up to 3 feet on the trunk has been advised on seedlings planted in 1927-1928. It is considered

that not only is the budding of trees of this age and size a practical proposition, but that there is evidence to show that the scion has an influence on the yield of the stock, so that tapping can be carried out eventually on both the scion stem and the stock.

Normally, however, such high budding is only recommended on trees of this age and size when the operation cannot be performed so successfully just above the collar. Whenever possible at present, budding of 12 to 18 months' old stock is advised.

On one estate in the coastal district, it was found that the budding wax used on the waxed binding cloth caused considerable damage to the bark. This on investigation was proved to be due to the excessively hot dry weather which caused the wax to melt and to be absorbed by the bark. Observations on the site showed that, in every case, the damage was on the western side of each tree and was caused by the hot afternoon sun on the dry bark. On the eastern side the bark in the morning was sufficiently damp to prevent such damage.

It is also of interest to record that the general tendency in Malaya is towards block or mono-clone planting instead of the planting of mixed clones, especially when well known clones with a sufficiently long tapping record are used. Recommendations for the adoption of monoclonal, duoclonal or mixed clone planting with 5 or 6 clones are based on the performance of the clones available and the record of tapping of such clones.

POLLINATION AND SEED SELECTION

Work on cross pollination of the Pilmoor Estate clones has been continued. The successes obtained have been very similar to those obtained during 1929. No factor has yet been discovered which can be definitely stated to have a specially favourable or adverse effect on pollination.

The prolonged dry hot weather during 1930 and also the occurrence of *Oidium* disease on the inflorescences has, however, had a bad effect on the setting of seed.

IDENTIFICATION OF CLONES

Further observations have been made on certain vegetative characteristics of clones, which enable identification to be effected. Notes and drawings indicating these special characteristics in respect of several well known clones have been prepared and can be obtained on application to the Director.

TAPPING

Owing to lack of sufficient staff and general slump conditions, it has not been possible to carry out any extensive experimental work on tapping, except on the Pilmoor Estate clones.

A few estates, however, have, at the request of the Institute, laid down experiments on the cessation of tapping on Sundays. The records of these will be analysed after they have been continued for a complete season.

The results to-date indicate that the loss, with an alternate day tapping system, which is the generally adopted system of tapping in Malaya, is represented by the loss of crop on the Sunday, with no other effect on the following days either in respect of a decrease or increase.

This represents, with 180 tapping days, a loss of 26 days or an approximate reduction in crop of about 14 per cent.

Experiments are still in progress on methods of bark treatment both in relation to increase in yield of latex and bark renewal. From the results obtained on one or two estates, there are indications that, while certain treatments may cause a temporary increase in yield which is of value when thinning out or removal of trees for re-planting is to be done, such methods are probably of the greatest value in improving bark renewal when trees are rested. Certain protective coverings appear to improve bark renewal and also to result in a softer bark more suitable for subsequent tapping. Further controlled experiments are, however, required before such treatments can be definitely recommended.

On several estates the value of intensive tapping of old trees which are to be removed for planting of budded material has been demonstrated. On some poor yielding areas, a two years' normal crop has been obtained in 6—9 months.

IMPORTATION OF BUDDING MATERIAL AND SPECIAL SEEDS

The importation of budwood, budded stumps and special seed chiefly from the Netherlands East Indies is shown by the following figures, for which I am indebted to the Director of Agriculture, S.S. & F.M.S. These figures are supplied monthly and during the last year details have been supplied in respect of the particular clones imported.

Budwood imported	...	70,448 metres (approx.)
Budded Stumps imported	...	104,497
Special Seed imported	...	95,000

The quantity of budwood imported is only about one half the amount imported during 1929, but this does not necessarily indi-

cate any decrease in the amount of budding carried out, since much locally grown Java and Sumatra budwood is now available from multiplication nurseries, while budwood from promising Malayan clones is also being used.

The number of budded stumps is slightly below the number imported in 1929, while the amount of special seed is only about 10 per cent. of the importation during 1929.

The largest quantities of budwood imported, totalling 50,300 metres, were from the following Clones:—

AVROS	Clone	49	...	10,800	metres (approx.)	
BD	"	5	...	10,500	"	"
AVROS	"	50	...	9,600	"	"
"	"	152	...	9,200	"	"
"	"	256	...	4,100	"	"
BD	"	10	...	2,600	"	"
Tjirandji	"	1	...	1,800	"	"
AVROS	"	71	...	1,600	"	"

The budded stumps included approximately 72,000 of AVROS clones Nos. 49, 50, 152, 163, 256 and 271 imported by one firm, 27,000 of AVROS clones Nos. 49, 50, 123 and 256, and 1,000 of Tjirandji clones No. 1 by another firm, which amount to 100,000 stumps out of a total of 104,197.

The special seed imported consisted of 56,000 Tjikadoe seed, 34,000 Wangoenredja seed (both from the Anglo-Dutch Plantations, Java) and 5,000 Soekapoura seeds imported by three firms, and distributed among various estates of which 25,000 Wangoenredja seeds were sent to one estate, 30,000 and 10,000 Tjikadoe seeds to two other estates respectively, 6,000 Wangoenredja seeds to another estate and three lots of 5,000, 5,000 and 3,000 Tjikadoe seeds respectively to three other estates, while the 5,000 Soekapoura seeds were sent to another estate.

Diseases and Pests.

Several useful investigations have been continued during the year and brought to a sufficient stage for publication of the results obtained.

OIDIUM LEAF DISEASE

The most important disease which has occurred during the year, in so far that its appearance and effect hitherto have been negligible is secondary Leaf-fall caused by the fungus *Oidium Heveae*, commonly known as the Mildew fungus.

As is generally well known this disease is endemic in Java and Ceylon and was first noted in Malaya by Sharples in 1925.

An extensive outbreak of the disease, causing a second defoliation immediately following re-foliation after the usual wintering in February–March, occurred principally in the Southern portion of the Negri Sembilan, F.M.S. and the Northern portion of Malacca, S.S., in the latter part of March.

As more recent investigations by the Pathological Division have shown, the fungus has been probably present the whole time, and it is considered that the exceptionally prolonged dry weather following the usual dry spell during the wintering period of the rubber tree in Malaya (February–March) was responsible for the virulent outbreak during 1930.

At the same time, it must be emphasized that the rubber tree in Malaya may become less immune, that is, the fungus may become more virulent and widespread in its attack and effect.

An important observation in relation to this fungus is that it appears to be carried over from one season to another on the inflorescence of the rubber tree. Abnormally dry weather is responsible for a spasmodic and extended flowering season, so that the fungus may be present on some trees on the estate throughout the year. The spores may also be kept alive in other ways, so that the fungus may develop at any time if the conditions are favourable.

It does not, however, appear to cause any marked or serious effect on mature leaves, so that an outbreak may be anticipated chiefly when the trees are re-foliating after wintering.

Although both in Java and Ceylon, experiments have shown that the disease can be dealt with effectively by sulphur dusting, further experiments are necessary, especially in Malaya, to determine the economics of this method of control, in respect of the most suitable dust sprayer, the amount of sulphur to be applied, the frequency of application and the most economical and suitable type of sulphur.

It is proposed during the next season, if conditions are favourable, to carry out intensive and extensive dusting operations with two types of dusting machines which have been purchased by the Institute, using Flotate sulphur from Java, which, at present, is the cheapest type of this substance obtainable locally. This sulphur is a fine volcanic sulphur prepared in Java. Certain estates also propose to use the cheaper but less pure mud sulphur from Java and the results obtained with this material will also be observed.

Although it has been stated in a previous article published in the Quarterly Journal (Vol. 2, No. 2) that the cost may amount to \$4/- per acre, it is hoped to be able to reduce this by efficient work when the labour force has been trained to operate the machines. It is also probable that the present machines will be improved with experience.

Although sulphur dusting by means of aeroplanes has been tried in Java, the difficulties experienced and the cost render this method

of application impracticable at present. In any case, only large contiguous areas could be dusted by such means. This is authoritatively stated also by Dutch experts. The published result of all experimental work in relation to the combatting of this disease in the Netherlands East Indies and in Ceylon is being carefully watched and in addition correspondence on various points in relation to treatment and the suitability of dusting machines is being carried on.

As a result of the recent outbreak in Malaya, the disease has been declared a Notifiable disease under the Agricultural Pests Enactment, F.M.S. No. 30 of 1926, Section 19 and the Agricultural Pests Ordinance, S.S. No. 166.

When the disease is suspected the Chief Agricultural Field Officer of the Department of Agriculture, S.S. & F.M.S. or the nearest Agricultural Field Officer of that Department should be notified. At the same time specimens of leaves and flowers on which the disease is suspected should be forwarded to this Institute for diagnosis.

OTHER LEAF DISEASES

No other serious leaf disease occurred, but a number of cases of Bird's Eye Spot caused by the fungus *Helminthosporium Heveae* Leaf tip scorch and Die-back of young leaf tips of budded stocks have been recorded.

These were accentuated primarily by physiological conditions due to the unusually prolonged drought last year following the normal wintering season.

BARK AND STEM DISEASES

Mouldy Rot caused by the fungus *Sphaeronema fimbriatum* again became virulent, especially on small rubber holdings towards the end of the year when the rains commenced and the humidity was high.

Arrangements have been made in collaboration with the Department of Agriculture to initiate experiments with various fungicides for the control of this disease. As is well known, two or three proprietary fungicides are at present recommended and it is considered desirable to ascertain which is the most satisfactory and economical and whether other suitable and more economical mixtures can be prepared by methods which are sufficiently simple for use on both large estates and small holdings.

Several interesting cases of Internal fissures in the cortex of the rubber tree have been investigated and described, but no causal organism or physiological basis of this affection have been discovered.

A valuable and informative paper on Brown Bast disease of the cortex was published by Dr. Rhodes in the Quarterly Journal (Vol. 2, No. 1).

INSECT AND ANIMAL DAMAGE

Grasshoppers and certain caterpillars have been reported as causing damage on a few small areas and recommendations for treatment by means of poison sprays have been made.

White ants (*Coptotermes*) have also been reported on a few areas and recommendations made for treatment with arsenical-sulphur fumes or the local application of mercuric chloride solutions.

One or two instances of bad attack by scale insects (*Lecanium sp.*, *Pulvinaria sp.* and *Melolontha sp.*) have also been recorded. These may become serious if the attack is neglected in the early stages.

Squirrels have been reported as causing damage on several estates to the renewing cortex on the tapping panel and on branches of rubber trees. Such damage on smaller branches is usually indicated by its occurrence in short narrow spirals with undamaged bark between. It is thought that the feeding of the squirrels on the soft renewing cortex of the tapping panel is probably caused by lack of other food-stuffs due to the drought.

A deterrent against deer attack, consisting of a mixture of whale (or fish) oil and tar has been used on several estates. On account, however, of severe damage to the bark by the application of this mixture on one estate, further investigation is required as to the utility of the mixture. Unfortunately the tar used in such mixtures and in various fungicides is not of standard composition and the application of such mixtures may cause more damage than the disease or pest against which they are used as a deterrent.

FUNGICIDES AND WOUND TREATMENT

A valuable investigation has been carried out by the late Mr. Sutcliffe on the use of Asphalts and Bitumens for wound treatment and pruning cuts.

It has been found that a mixture of asphalt with kerosene or crude oil, with or without the admixture of a fungicide, according to the treatment required, constitutes a valuable dressing in the case of budding operations, pruning, windbreaks or other wounds.

This mixture penetrates the tissues only to a slight extent and forms an elastic, permanent covering on wounds, which is far more effective than the usual tar dressing. The results of investigations on such mixtures have been published in the Quarterly Journal (Vol.

2, No. 3, 1930). It is probable that the bitumen or asphalt emulsions which are now available may prove to be more suitable for this purpose.

ROOT DISEASES

Investigations have been continued on two estates on the incidence of root disease in rubber trees of different age classes.

This investigation has shown the significance of *Fomes pseudo-ferreus* as a limiting factor in the stand of old trees and the advantages of replanting with high yielding material on such areas, instead of expensive, uneconomic and possibly valueless treatment of the old trees.

A report on this investigation will be published when the work has been completed.

DISINFECTION OF BUDWOOD

Preliminary experiments on the disinfection of budwood for import and export have been carried out in relation to the effect of the various treatments on the viability of the buds. The results are published in the Quarterly Journal Vol. 2, No. 4.

In the event of the possible introduction of certain diseases by the importation of infected budwood and budded stumps, it may be essential to insist in certain circumstances on the disinfection of such material.

Chemical and Bacteriological Investigations on Latex and Rubber.

Fundamental researches on latex and rubber have again been affected by shortage of staff, although progress in several directions can be recorded.

NON-CAOUTCHOUC CONSTITUENT OF LATEX.

An investigation of the Lipin bodies in latex has been made and the influence of these substances on the properties of raw rubber, particularly in relation to variability in plasticity, is indicated.

The effect of the carbohydrate constituents of latex on rate of vulcanisation of raw rubber is also indicated by investigations which are in progress on the addition of different sugars to raw rubber mixings.

Preliminary investigations on the differences in colour of the coagulum caused by oxidation of certain constituents of latex from

specific clones, indicate the importance of a study of the latex and rubber derived from different clones.

PRESERVATION AND COAGULATION OF LATEX

In relation to the preservation and coagulation of latex, an investigation of the hydrogen ion concentration of latex under different conditions has been carried out and the results have been published in the *Quarterly Journal* (Vol. 2, No. 3.)

This investigation indicates the influence of certain non caoutchouc constituents of the latex on coagulation phenomena and confirms the results of similar investigations carried out simultaneously by van Harpen of the A.V.R.O.S. Proefstation, Sumatra.

PRESERVED LATEX

It is hoped shortly to continue investigations on the preservation and concentration of latex, when suitable plant has been obtained for carrying out such work on a semi-commercial scale.

Consignments of latex preserved with alkaline soap have been despatched to Great Britain with the object of determining whether these methods can be adopted in place of the somewhat expensive preservation with ammonia.

Investigations on the preservation of latex on estates, with the object of transporting latex for long distances and the centralisation of factories for coagulation are in progress.

Correspondence on standards for preserved latex, in regard to colour and other factors has taken place between the Consulting Chemist of the Rubber Growers' Association (Dr. H. P. Stevens) and the Institute, in relation to conditions of contracts formulated by the Rubber Trade Association, London.

The large scale export of preserved latex from Malaya by the United States Rubber Plantation's Process Department has ceased. A number of estates have, however, continued to export consignments of latex preserved with ammonia, presumably for experimental purposes.

CONCENTRATED LATEX

Two processes of concentration have been continued in Malaya during the year, viz. the centrifugal process on an estate belonging to the Dunlop Rubber Plantations Ltd., and the Revertex process of concentration of latex by evaporation in the presence of a protective colloid or stabiliser.

The latter process has been commenced on a second estate in Malaya, but was discontinued towards the end of the year on the estate on which it was originally started.

SHEETING MACHINERY

In relation to a questionnaire on the output of dry rubber from light sheeting batteries circulated by the Chemical Division, an important advance has been made by a study of this problem and by subsequent investigations.

It has been found possible by the use of deeper coagulation tanks combined with wide roll machines and the harmonizing of roll speeds, to obtain outputs of 1200—1400 lbs. of dry rubber per hour on light batteries consisting of three smooth roll (24 inch wide) machines and one marking machine, which is nearly three times the normal output obtained in previous practice.

This is of considerable importance in relation to costs and to the size of unit required to treat a specific crop especially on estates which have to erect new factories. The results also demonstrate that economies can be effected by the further centralization of factories.

Further investigations on the installation of machines in parallel instead of in line and also of multiple roll machines are in progress.

STRAINING OF LATEX

One of the principal complaints against smoked sheet is the presence of speckiness in the sheet.

It has been found that this speckiness is frequently caused by fine sand, which passes through even an 80 or 100 mesh horizontal sieve.

Investigations have shown the importance of settling tanks, combined with dilution of the latex and the addition of sodium sulphite to reduce the viscosity of the latex in such tanks in order to remedy this defect.

Box sieves with vertical or slightly sloping strainers are also recommended in place of the usual horizontal sieves.

SMOKED SHEET AND SMOKE HOUSES

A questionnaire circulated by the Chemical Division has elicited the fact that the Devon type of smoke house is the most efficient. Further investigations are in progress in regard to the most suitable type of furnace and the distribution of heat and smoke in the smoke houses.

AIR-DRIED SHEET

Further investigations on the preparation of air-dried sheet are in progress; the application of low voltage electric current to supply heat in drying rooms where a cheap supply of electric current is available is being examined.

The application of electrical heating for this purpose has many advantages, but the main problem is the cost of the current.

SOLE CREPE

Sole crepe still continues to be a profitable preparation on a number of estates, although any extensive increase in the manufacture of this product would probably spoil the market.

The principal problem which has arisen in relation to the product is variability in hardness, the causes of which still require investigation.

BACTERIOLOGY OF LATEX

The results of an investigation on the bacteriology of latex have been published in the Quarterly Journal (Vol. 2, No. 2, 1930) and two organisms which are of importance in relation to natural coagulation have been isolated and investigated.

MINERAL CONSTITUENTS OF LATEX

In connection with the use of potassium permanganate in a mixture recommended for the preparation of an imitation smoked sheet, an investigation of the manganese content of various samples of raw rubber has been carried out.

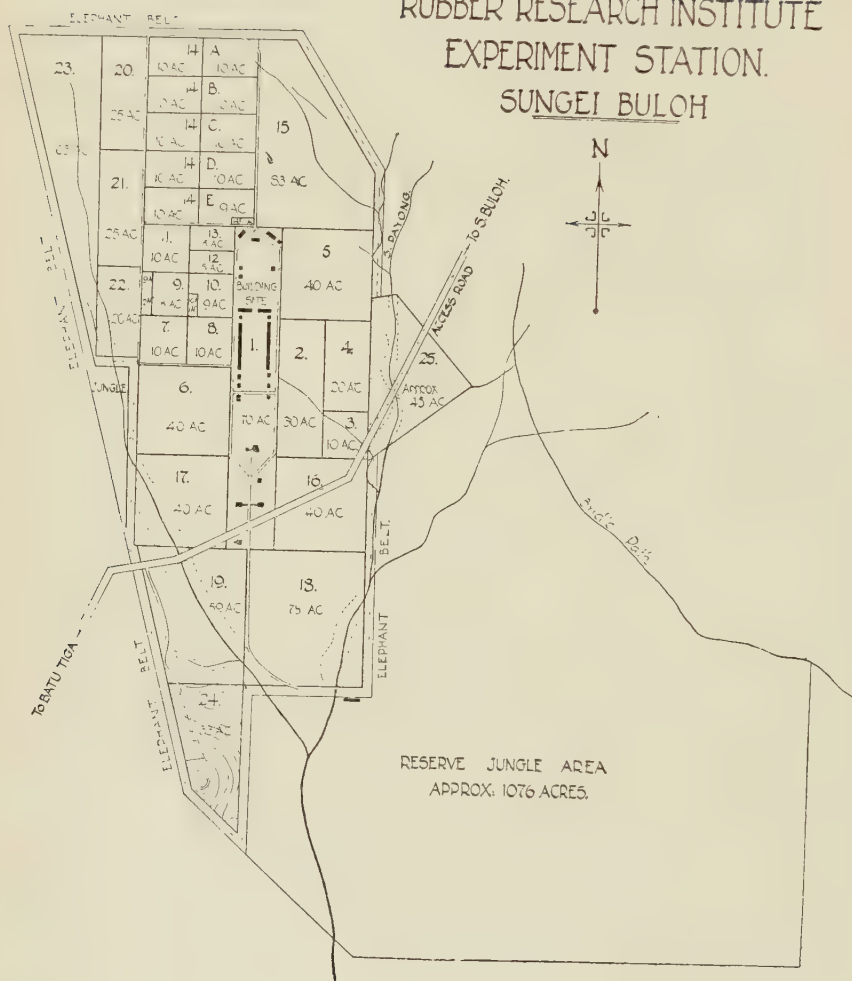
The results have been published in the Quarterly Journal Vol. 2, No. 4. The investigation will be continued, since the effect of manganese salts and other metallic compounds on raw rubber, especially after storage, depends not only on the amount of the substance present, but also on the state of combination of the metal.

In view also of the known oxidizing effect of certain salts of copper, manganese and iron on raw rubber, causing tackiness and eventual conversion of the raw rubber into resins, further investigation of the natural antioxidants in rubber and of the addition of anti-oxidants for the reduction or prevention of such oxidation is essential.

Experiment Station.

The Report by the Manager indicates the progress made on the Experiment Station during the year.

RUBBER RESEARCH INSTITUTE EXPERIMENT STATION. SUNGEI BULOH



No new area has been opened up from the reserve jungle, but the so-called Sungei Payong area (Block 25) of about 45 acres has been acquired by the Institute from the Forestry Department and is being prepared for extension of planting for the Botanical Division.

The acquisition of this area, which had previously been felled and cleared before it was taken over, has also enabled us to clear out a small village of squatters and to improve considerably the health of the estate, especially in relation to malaria, since the ravine and stream in this area formed a breeding ground for mosquito larvae, over which we had no control. The area acquired is also valuable for planting purposes.

AREA OF EXPERIMENT STATION

The area of the Experiment Station is approximately 2,045 acres which includes 969 acres already opened and 1,076 acres of reserve jungle. The details of the area opened and the allocation of the various plots is shown in the Manager's Annual Report. The experiments which have been laid down on the various blocks are detailed below :—

Block No.	Area (acres)	Area planted (acres)	Experiment or Allocation
1	70	—	... Building site.
2	30	30	... Collection of seedlings from seed of historical trees in Malaya, Ceylon and Java.
3	10	8	... Budded from 1928 Pilmoor crosses in Block 4.
4	20	20	... (a) 10 acres Pilmoor 1928 crosses and controls. (b) 5 acres of nurseries. (c) $2\frac{1}{2}$ acres of twin seedlings. (d) $2\frac{1}{2}$ acres. Comparison of seed at stake, germinated seed and stumps.
5	40	40	... Clone Trial Plot for comparison of 9 Malayan, Java and Sumatra Clones.
6	40	40	... Manurial Experiment (5 different treatments with controls—replicated 6 times).
7	10	10	... Comparison of seed at stake, basket plants and stumps and crowbar planting of stumps, combined with covering of stumps, combined with cover crops (three species) v clean weeding experiments. Uncleared areas.

Block No.	Area (acres)	Area Planted (acres)	Experiment or Allocation
8	10	10	... Experiment as in Block 7 but areas clean cleared. Blocks 7 and 8 are laid down to determine incidence of root disease under clean-cleared and non-clean-cleared conditions and relation of cover crops to root diseases also to compare growth under the different conditions.
9A	2	—	... To remain fallow for 5 years, not cleared of timber but clean weeded. To determine influence of long exposure on longevity of soil and wood-destroying fungi and on the effect of the treatment on the soil.
9B	8	8	... Basket planting. Experiments on immunity to diseases.
10A	1	1	... Seed at stake. Cover crops (Mixture of Calopogonium, Centrosema pubescens and Vigna) to determine various disease factors.
10B	9	9	... Seed at stake for budding. Experiments on root disease control and immunity to root diseases. Vigna planted in alternate rows.
11	10	10	... Planted with stumps, basket plants and seed at stake. Secondary growth (belukar) allowed to develop. No weeding except removal of lallang grass. Half the area is slashed twice a year. To determine effect of belukar on growth and incidence of root disease.
12	5	5	... Nurseries. Study of diseases and treatment. Wound dressing experiments and spraying for leaf diseases.
13A	2½	2½	... Cover plant nurseries. Collection of different varieties.
13B	2½	2½	... Collection of cover crops under rubber trees. Seed at stake planted.
14A-E	99	99	... Density Experiment. 5 plots of approx-20 acres each with normal seedling material planted at (A) 435, (B) 302, (C) 222, (D) 108 and (E) 48 plants per acre.

Block No.	Area (acres)	Area planted (acres)	Experiment or Allocation
<i>Note.</i> —Central Plots C and D since divided into randomised plots of approx. 1 acre each under different planting distances. All plants in these plots budded with Clone AVROS 50.			
14F	1	1	... Jungle felled and removed without burn-to ascertain effect on growth of rubber trees.
15	83	83	... Seedlings for budding with buds from high yielding trees from various Malayan estates, in order to establish new clones.
16	40	35	... (a) Pilmoor Estate Clones (1929) crosses and controls. (b) Families of individual tree seedlings for variability trials.
17	40	40	... (a) Manurial trials on plots of mixed seedling and budded rubber under clean weeding and cover crops. (b) Cover crop experiments—shading, manuring, digging in; effect on the growth of rubber trees. (c) Mulching and manuring of nurseries. (d) Periodical digging in of grass.
18	78	73	... Planted for future budding for tapping experiments.
19	59	57	... Plants budded with Clone BD 5. Selective weeding. Grass covers allowed to grow.
20	25	25	... Study of soil flora under different cover crops. With control clean weeded plots. To be budded later.
21	25	25	... Planting with Stumps, Basket plants and Seed at stake. Cover crop plots and control clean weeded plots. Treatment with soil fungicides. To be budded later.
22	20	20	... 3 acres dug to 3 ft. and completed cleared of all buried wood. 10 acres non-Hevea rubber plants.

Block No.	Area (acres)	Area planted (acres)	Experiment or Allocation
23	65	65	... Rubber interplanted with (a) Tapioca (13 acres) (b) Pineapples (11 acres) (c) Coffee (19 acres) with control plots to test effect on growth of the rubber plants. Experiment on treatment of soils with different amounts of lime.
24	33	33	... Hill area : experiments on terracing and cover crops on steep land. Plants budded with Clone BD 5.
25	45	5 (approx)	... Filmoor 1930 Crosses and Nurseries.

It has been decided to make certain alterations in the planning programmes on the Blocks previously allocated to the Pathological Division, but the final arrangements for these alterations have been left for discussion and decision during 1951 after the new Head of the Pathological Division has assumed duty.

The allocation of the various blocks and the nature of the experiments which are being carried out on these blocks, given in the list above, therefore shows the position at the end of the year and does not indicate the alterations which will probably be made.

The completion of the hostel greatly facilitates the work of the research staff of the Institute, since it is now possible for officers to visit the Station over-night and carry out, if necessary, a whole day programme of work on the Station.

An excellent water supply scheme has now been completed which is of great benefit to the labour force.

The planted area suffered considerably from drought during the year, since the year was one of the driest in Malaya since 1911. Retardation of growth was observed particularly in young rubber plants of a certain age, in which the root development had not reached a sufficient stage to withstand such dry conditions. Measurements and observations carried out by the Soils Division in relation to this problem are of interest. After the plants reach a particular stage of growth, when the root development is sufficiently extensive to absorb the necessary water and the plant food constituents contained in the soil water for normal or satisfactory growth, no retardation is observed. The particular feature indicating retardation in growth, due to an insufficient supply of soil moisture, is the formation of a corky tip of the main stem, which remains stationary in growth, whereas under normal conditions of growth, in the presence of a sufficient water

supply, the terminal bud develops into the normal whorl of young leaves.

The dry conditions also badly affected the growth of *Vigna* (*Dolichos Hosei*) and indicate that this cover crop is not satisfactory on the soil on this area. *Centrosema pubescens* and *Calopogonium mucunoides* are not affected by these dry conditions and these cover crops are now being established on areas on which the *Vigna* has died, in order to save weeding costs and to conserve the soil humus.

Records of growth in relation to various experiments are being taken and it is hoped shortly to publish information on the results already obtained from various methods of soil treatment.

Many planters and visitors from foreign Research Stations have visited the Station during the year.

Agri-Horticultural Shows.

LOCAL AGRICULTURAL SHOWS

A very successful Agri-Horticultural Show -and Trades Exhibition was held under the auspices of the Malayan Agri-Horticultural Association at Kuala Lumpur from 19th to 21st April.

This Institute and the Department of Agriculture paid the major portion of the cost of erection of a wood and attap-roofed building to house the exhibits of both organisations.

Comprehensive specimens, models, water colour paintings and photographs of the major diseases of the rubber tree and the principal fungicides used for treatment of such diseases were exhibited by the Pathological Division.

Budding was illustrated by means of actual plants, and photographs of the operation, prepared by the Botanical Division, while budding demonstrations were given several times daily to large and interested audiences.

A comprehensive exhibit of raw rubber showing various defects, exhibits to illustrate the best methods of treatment of latex in preparing the raw product, the latest improvements in factory utensils, strainers and tanks and exhibits of factory chemicals for the coagulation and preservation of latex were staged by the Chemical Division.

Leaflets describing the principal diseases of the rubber tree and the treatment of such diseases and on defects in raw rubber were printed for distribution.

Demonstrations were also given on two mornings to Malay headmen and members of Rural Credit Co-operative Societies.

Rubber exhibits were also staged at District Agri-Horticultural Shows held during the year at Taiping (Perak North), Seremban (Negri Sembilan), Kuantan and Temerloh (Pahang), Alor Star (Kedah) and Malacca. Officers of the Institute were in attendance to give advice.

ANTWERP EXHIBITION

A comprehensive exhibit comprising the various types of raw rubber prepared in Malaya, preserved and concentrated latex, factory utensils and chemicals used in the preparation of raw rubber, specimens of rubber trees attacked by various diseases, together with paintings, photographs and literature illustrating and describing the exhibits was despatched to the Colonial and Maritime Exhibition held at Antwerp (Belgium) from May to October, 1930.

The exhibits also included commercial samples of well prepared plantation raw rubber of different grades which were kindly presented or loaned by various Agency firms and estates in Malaya.

Although no official report has yet been received, it is understood that the exhibits despatched by the Institute were entirely satisfactory.

The Malayan Information Agency was authorised to retain or distribute all the exhibits, except certain samples of estate rubber which were on loan.

Conferences.

An Inter-departmental Conference embracing the Department of Agriculture, S.S. & F.M.S., the Co-operative Societies Department, F.M.S. & S.S., the Veterinary Department, F.M.S. and this Institute was arranged by the Director of Agriculture, S.S. & F.M.S. and held from the period October 27th to November 1st. The Conference which was opened by the Hon'ble the Chief Secretary to Government, Federated Malay States, was a great success and also helped to consolidate the co-operation between the different organisations which took part.

The following papers were read by members of the staff of this Institute:

- (a) "The Application of Budding to Kampong Conditions"
by C. E. T. Mann.
- (b) "Preparation of Rubber from the point of view of Small Holders" by R. O. Bishop.
- (c) "Mildew Disease of Hevea and Control of Mouldy Rot"
by F. Beeley.

- (d) "Soil Conservation and Manuring in relation to Rubber"
by C. F. Flint.

Lectures.

The following lectures were delivered during the year:—

Botanical Division	...	4
Chemical Division	...	3
Pathological Division	...	1
Soils Division	...	4

—
12
—

The subjects dealt with at the above lectures were as follows:—

- (1) Factory Procedure.
- (2) Germination of Rubber Seeds.
- (3) Rubber Soils and the Manuring of Rubber Trees.
- (4) Soil Conservation and the Effect of Cover Crops.
- (5) Budding of Rubber Trees.
- (6) Rubber Tree Diseases.

The above lectures were delivered before branches of the Incorporated Society of Planters at the following centres:—

Central Johore	...	3
Kelantan	...	1
Sitiawan	...	1
Taiping	...	1
Tampin	...	3
Telok Anson	...	1

One lecture was given to planters at the Kuantan Club and another before the Negri Sembilan Planters' Association.

Several lectures arranged to be held towards the end of the year were postponed at the request of the planting organisations concerned, owing to the difficult situation caused by the slump, which rendered it impossible to guarantee a good attendance. For the same reason, the Annual Conference of the Incorporated Society of Planters was also abandoned.

Publications.

The following publications were issued during the year:—

1. *Quarterly Journal*. Three numbers (Vol. 2, Nos. 1, 2 and 3): a fourth number (Vol. 2, No. 4) has also been prepared for printing.

2. *Annual Report for 1929.*

3. *Information Cards* (Nos. 1C to 15C), on "The Preparation of and Defects in Raw Rubber", prepared by the Head of the Chemical Division.

4. The following articles prepared by the staff of the Institute were published in the *Malayan Agricultural Journal* and the *Vernacular (Malay and Chinese) Journals* issued by the Department of Agriculture, S.S. & F.M.S.

1. Rejuvenation and Replanting of Rubber by B. J. Eaton. (*Malayan Agricultural Journal*, Vol. XVIII, No. 3).
2. Manuring of Rubber by W. B. Haines. (*Malayan Agricultural Journal*, Vol. XVIII, No. 5).
3. Mildew Disease of Hevea by F. Beeley. (*Malayan Agricultural Journal*, Vol. XVIII, No. 12).
4. Budding of Rubber by C. E. T. Mann. (*Chinese Vernacular Journal*, Department of Agriculture, S.S. & F.M.S., Vol. 4, No. 2 and *Malay Vernacular Journal*, Department of Agriculture, S.S. & F.M.S., Vol. 8, No. 2).
5. Notes on the Care of Rubber Trees, Tapping and Preparation of Rubber by B. J. Eaton. (*Malay Vernacular Journal*, Department of Agriculture, S.S. & F.M.S., Vol. 8, No. 3 and *Chinese Vernacular Journal*, Department of Agriculture, S.S. & F.M.S., Vol. 4, No. 3).

Leaflets in English on the principal diseases of the rubber tree, including a brief description and methods of treatment were published for use at the local Agricultural Shows and for distribution to estate managers in reply to enquiries. A number of these are also being translated into Jawi (Malay) and Chinese by the Department of Agriculture for use among small holders cultivating rubber.

Similar leaflets on the common defects in raw rubber and on methods of preparation and other details concerning rubber estate factory practice have also been published.

A Set of Information Cards, similar in character to the leaflets, on the preparation of and defects in raw rubber, has also been prepared by the Head of the Chemical Division and issued. These cards are contained in a loose leaf cover, so that additional cards can be inserted as and when issued. These cards appear to serve a very useful purpose and have been in great demand.

The cards are issued free on request, but a charge of 35 cents (Straits currency) is made for the cover. These leaflets and cards also serve a useful purpose in relation to many enquiries received

from estates. Considerable time is saved by despatching a leaflet or card in reply to such enquiries.

In relation to vernacular publications (in Jawi and Chinese) which are issued by the Department of Agriculture, it has been decided to give an annual grant of \$2,000 to the Department. All articles on rubber for use among small holders are printed in these vernacular publications or in the form of leaflets which are translated and issued by the Department of Agriculture.

Visitors.

A feature of the year, as during 1929, has been the large number of visitors to the Institute and to the Experiment Station. These include many planters who come to discuss various problems of estate practice.

The visitors included His Excellency Sir Cecil Clementi, K.C.M.G. (Governor of the Straits Settlements and High Commissioner of the Malay States); His Excellency Hon. Mr. John Scott, C.M.G. (Officer Administering the Government, S.S. and High Commissioner, F.M.S.); Sir L. H. Elphinstone, K.C., Chief Justice, F.M.S. and Lady Elphinstone; Prince Purachatra, Siam; M. Ballereau, French Consul, Singapore; the Hon. Mr. R. D. Denman, London; M. Maus, Managing Director, S.I.P.E.F., Antwerp; Dr. Ambros, I.G., Farbenindustrie, Ludwigshafen, Germany; Dr. P. J. S. Cramer (Adviser to various estates in the Far East, formerly of the Department of Agriculture, Commerce and Industries, Netherlands East Indies); Dr. d'Angremond (Director) and Ir. J. F. Schmole (Algemeen Proefstation der A.V.R.O.S., Sumatra); Mr. J. Grantham (Director of Research, Holland-American Plantations Maatschappij, Sumatra); Mr. H. J. Page, M.B.E. (Director, Jealotts Research Station, Imperial Chemical Industries).

General.

FIELD DIVISION

As indicated in this Report, a Field Officer has been stationed throughout the year in the State of Johore. This has relieved officers of the Research Divisions of a lot of travelling and has at the same time enabled them to keep in close touch with rubber planting problems in the State. Special problems on which the Field Officer is unable to advise are referred to Headquarters.

The services of the Field Officer stationed in Johore are also available for the island of Singapore. It is also intended, as soon as the Field Division staff is again complete, to allocate a Field Officer to Kedah. Owing to housing difficulties, it will probably

be necessary to station this officer in Province Wellesley and it is intended that he shall deal with advisory work in Kedah, Province Wellesley and probably Northern Perak and shall also pay an annual visit to the States of Kelantan and Trengganu.

ACKNOWLEDGMENTS

I again wish to express my thanks to members of the Senior and Junior Staff for their loyal support during a difficult year in which the work has had to be carried out during most of the time in the absence of a substantive Head in all Divisions. This has naturally thrown much additional work and responsibility on many officers.

B. J. EATON,

Director.

APPENDIX.

Analysis of Advisory Correspondence, 1930

SOILS DIVISION.

Subjects	Letters received.	Letters. despatched.
Cover Crops ...	20	21
Manuring ...	262	336
Conservation of Soil ...	20	26
Drainage ...	17	19
Replanting ...	23	27
Fertilizers ...	29	31
Soil Samples ...	151	187
Miscellaneous ...	26	41
Total ...	548	688

BOTANICAL DIVISION.

Subjects	Letters received	Letters despatched
Budding—General ...	472	568
„ Training of Conductors and Pupils from Estates, etc. ...	12	14
„ Field Trial Experiments ...	8	25
Budwood—Purchases and Exchanges ...	63	76
„ Packing and Treatment ...	2	2
Budding—Special Materials ...	16	16
Tapping—(General) ...	54	52
„ Tapping of Budded Trees ...	1	1
„ Estate Experiments (General) ...	15	18
„ Estate Experiments (Tapping of Budded Trees) ...	60	86
Test Tapping of Seedlings ...	15	16
Tapping—Tapping Systems (Sunday Tapping) ...	63	66
Tapping—(Utensils) ...	7	9
Selection—Individual Mother Trees ...	248	238
Estate Yields ...	1	1
Seed Selection ...	72	84
Latex Vessel and Bark Examinations ...	6	8
Isolation Seed Gardens ...	9	13
Pollination ...	5	9
Seeds (Germination) ...	3	4
Packing ...	1	2
Seeds for Experimental Purposes ...	13	15
Requests for Seed ...	4	4
Seed—Identification, etc. ...	3	3
Non-Hevea Rubber Plants ...	8	10
Cover Plants ...	23	45
Catch Crops ...	2	2
General Physiology ...	11	17
Apparatus ...	7	7
Planting Material ...	3	9
Total ...	1207	1420

PATHOLOGICAL DIVISION.

Subjects	Letters received.	Letters despatched
Root Diseases ...	94	130
Stem and Bark Diseases ...	87	104
Leaf Diseases ...	167	179
Fungi not proved Pathogens of Hevea...	6	7
Fungicides and Insecticides ...	54	69
Tree Operations ...	12	17
Floods ...	2	2
Injury by External Agents ...	102	123
Brown Bast ...	32	39
Epiphytes on Rubber Trees ...	2	2
Parasitic Phanerogams ...	4	4
Spraying and Dusting Equipment ...	12	16
Cover Plants ...	—	2
Miscellaneous ...	29	60
Total ...	603	754

CHEMICAL DIVISION.

Subjects	Letters received	Letters despatched
Anti-oxidants of Latex ...	4	5
Anti-coagulants of Latex ...	19	20
Machinery of Rubber Manufacture ...	49	53
Vulcanising Machinery and Apparatus	6	6
Vulcanisation of Rubber ...	35	44
Rubber Seed Oil ...	1	3
Rubber Oil ...	8	10
Crepe ...	46	48
Crepe—Lower Grades ...	22	28
Coagulants ...	15	16
Rubber Preparation ...	15	19
Latex ...	43	53
Latex Preservation ...	55	67
Latex Concentration ...	28	42
Latex—Instruments for determining D.R.C. ...	38	44
Coagulating Tanks and Pans ...	64	85
Sole Crepe ...	39	55
Smoked Sheet ...	280	299
Smoke Houses ...	60	73
Air-dried Sheet ...	36	45
Water ...	16	15
Accelerators of Vulcanisation ...	4	6
Miscellaneous ...	23	38
Rubber Roadways ...	13	19
Total ...	919	1093

CHIEF FIELD OFFICER.

Subjects.	Letters received.	Letters despatched
Cover Plants ...	15	17
Fertilisers ...	1	3
Replanting ...	1	2
Manuring ...	9	12
Bark Treatment Experiments ...	4	8
Drainage ...	4	5
Soil Conservation ...	1	1
Wintering and Fruiting ...	8	8
Fungicides ...	1	2
Injury by External Agents ...	9	10
Visits ...	4	6
Budding—Estate enquiries ...	4	4
Packing ...	1	1
Tapping ...	2	2
Miscellaneous ...	32	47
Total ...	96	128

Estate Visits.

The total number of visits paid to estates during the year by officers of the various Divisions is as follows:—

Soils Division	...	62
Botanical Division	...	229
Pathological Division	...	138
Chemical Division	...	129
Chief Field Officer	...	44
Field Officer, Johore	...	156

The visits under Botanical Division include 171 visits to Pilmoor Estate in connection with tapping experiments on the Pilmoor Estate Clones. Visits by officers to the Institute Experiment Station are not included in the list.

Mr. Beeley, Field Officer, was also sent to the States of Kedah and Kelantan to make reports on the conditions of small holdings, and while in Kelantan he also paid visits to all the principal large estates in the State on which a report was also submitted.

ANNUAL REPORT 1930.

SOILS DIVISION.

In May 1930 the Head of Division proceeded on long leave that lasted over the remainder of the year. The writer was appointed to act and remained the only European officer in the Division until October when Mr. C. G. Akhurst arrived from England to take up duties as a Research Officer. The amount of laboratory research work has been somewhat restricted by these circumstances since, as in previous years, it has had to wait on the full satisfaction of the field work and the incidental demand for numerous routine soil analyses.

Mr. Akhurst on his arrival was able to take over the supervision of the laboratory routine work and to undertake certain investigations that otherwise could not have been attempted owing to lack of personnel.

The depressed state of the industry made little difference to the volume of advisory work. Its character was, however, somewhat modified since Planting Companies were no longer able or inclined to undertake large manuring programmes. As a consequence, the demand for visits also fell off quite noticeably towards the end of the year and there was a complete absence of the "last minute" rush of fertiliser inquiries noticed in previous years before the approach of the main wintering season.

On the other hand, the demands on time made by the Experiment Station have increased considerably now that the experiments are past the incipient stage.

In previous years the cost of valuable experiments on mature rubber was borne by numerous estates throughout the country, the work being undertaken on the lines recommended by the Division. During 1930, relatively little new work could be undertaken by estates. In a number of cases, projected experiments or experimental re-planting programmes that had received much careful attention from the Division did not materialise. It is realised that this was inevitable.

Immediately previous to the May tapping holiday a number of inquiries were received on the subject of general cultivation and soil conservation work.

Advisory Work.

548 letters of inquiry were received and 688 advisory letters were written to estates, Agency Houses and individuals. An analysis of the correspondence is as follows :

Subject.	Letters Received.	Letters Despatched.
Cover Crops ...	20	21
Manuring ...	262	336
Conservation of soil ...	20	26
Drainage ...	17	19
Replanting ...	23	27
Fertilisers ...	29	31
Soil Samples ...	151	187
Miscellaneous ...	26	41
Totals ...	548	688

Twelve visits were paid to estates by the Head of Division before his departure and 56 during the year by the writer. This does not include visits to the Experiment Station at Sungei Buloh.

It is proposed now to discuss briefly the correspondence on certain of the matters indicated above.

COVER CROPS.

There were relatively few inquiries about cover crops, since the necessity of providing a cover on new clearings is almost universally recognised and its establishment is in most cases not difficult on virgin jungle soil. The question of covers under mature rubber has received attention and there is a growing recognition that the mere growth of a cover is not a universal remedy for trees in poor vegetative health. Particularly there are indications that it is more generally realised that on flat land under rubber in good foliage a cover crop is not only difficult to establish but is somewhat unnecessary. The bushy covers, although preferable in many respects to the creeping covers, have received little attention. *Centrosema pubescens* has been shown to make excellent growth on heavy grey clay soils. *Mimosa invisa*, though freely admitted to have remarkable powers of breaking up a heavy soil and restoring good tilth, is almost universally avoided by estate managers on account of the effect of its painful thorns on the labour force. Its use certainly requires organisation, and it is to be deplored that its dangers are avoided rather

than overcome as it is a most useful agent when properly controlled. The Division has frequently emphasised in the past that to obtain any appreciable manurial value from cover crops, they must be turned into the soil. There is now evidence that this point is more generally appreciated.

It is well known that young rubber grows more rapidly on clean weeded soil than on soil under a cover crop. There has naturally been a demand for precise information on this question. This more rapid growth is undoubtedly merely incidental to the wasteful consumption of soil humus reserves, the benefit accruing to the trees from the extra humus decomposition being relatively slight. A cover crop though giving slightly retarded growth conserves the capital reserves of the soil. Small fertiliser dressings given individually to the young trees would probably prove an economic way of getting the faster rate of growth with no prejudice to future soil fertility.

The foregoing remarks apply particularly to the planting of leguminous covers. Considerable interest has also been shown in indigenous covers. There have been sharp discussions concerning the value of grass as a cover; the position to date appears to be that certain grasses, if controlled, may be of real benefit but that others and especially those that form a close turf or root-mat at the surface are detrimental and must be avoided. Fern has also been discussed. Here again there are many species, some appearing to be of value and others harmful. The common bracken fern has been accused of drying the soil by excessive transpiration but has also been credited with the salvation of areas of young and mature rubber on washed and sun-baked hill slopes. Various methods of control have been used with success. Formation of woody growth should be avoided since, after slashing, the hard stems may cause dangerous foot and leg wounds to the labour force. Stagmoss continued to have a bad reputation as it is accused of producing sour soil conditions that favour dieback. As the only natural cover that appears on some areas it has valuable soil conservation properties on hill slopes. Further, it shades the soil surface and acts as a source of vegetable debris. There is reason to believe that it will only grow in rather exhausted and relatively acid soils, so that the dislike may be due to a confusion of cause with effect.

A natural cover of belukar (secondary growth) appears to have many practical and theoretical advantages. A number of cases have come to light where the soil reconditioning powers of belukar under proper control have been demonstrated. The whole question is being carefully reviewed.

MANURING.

The low price of rubber and a realisation that there is no certainty of success in the absence of direct experimental evidence on the

soil in question has led to great caution in the application of artificial fertilisers to mature rubber. The Division has, however, arrived at generalisations which in a large percentage of cases furnish a reliable guide to inquirers. Most estates lay down small experiments so as to be in a position to manure large areas with certainty when financial conditions are more favourable. Where no expert assistance has been sought experiments are generally of an unsuitable type and unlikely to yield reliable results. This question of manuring mature rubber is discussed further in a subsequent section of this report.

A relatively large amount of correspondence has dealt with the manuring of immature rubber. General success has been obtained with the use of complete soluble fertilisers such as Nitrophoska on very varied soil types and there is no doubt that this branch of the subject is on a much sounder basis. It should however be noted that one is concerned here with growth and not with yield of latex. Good growth and sound vegetative health are essential if an early opening up of the areas is desired, but do not appear necessarily to coincide with maximum yield in mature rubber.

CONSERVATION OF SOIL.

There were few inquiries in relation to methods of soil conservation since the ordinary systems of pitting, bunding or terracing are now standard estate practice. There has been a general adoption of the continuous bund built from the earth taken from the pits and placed on the upper side. Thus the pits act as a source of earth and as a safeguard in the case of a break, but the soil conservation is effected by the bund. The water instead of passing directly into the pit is held up over a wide shallow area and is forced to percolate through the surface soil conferring all the hygienic benefits of clean moving water and free aeration. Water collected in silt pits passes directly into the sub-soil. Working on these lines it is logical on steeper slopes to abandon pits completely and to concentrate on some form of excavated terracing system. There is also less chance of standing water on terraces without pits. Terraces have been adopted by numerous estates in their new plantings and are becoming increasingly popular. In qualification of the previous paragraph it should be mentioned that if silt pits are used on really steep land one is forced to bund on the down-hill side and accept any attendant disadvantages. Employing terraces on such sites, much can be said in favour of a line of small silt pits with stops, dug at the back of the terrace at its junction with the hill-side.

Numerous cases have been brought to our notice where the work of bunding or terracing mature rubber has given remarkable improvements in appearance and yield. Such benefits could be ascribed to soil aeration, conservation of water supply and of leaf fall or a

combination of these factors. Improvements were judged on a basis of past history. Although to the practical man the accumulation of evidence in favour of such work is so great as to be, in the mass, thoroughly convincing, no real experimental work has been done and no figures can be quoted for any single estate that would carry conviction to a scientist.

During the past year attention has again been directed to the menace to health of standing water in silt pits. In conjunction with the Malaria Advisory Board, the Institute published a report on "Silt-Pitting on Rubber Estates in relation to Mosquito Breeding and Malaria." The Head of Division was responsible for the expression of the Institute's opinions contained therein. The report was published in the *Quarterly Journal* (Vol. 2, No. 3) and in the *Malayan Agricultural Journal* (Vol. XVIII, No. 8). The crux of the problem from the agricultural point of view is that if there is standing water in silt pits, the system is not functioning properly and needs modification. There is thus no incompatibility between health and agricultural requirements.

DRAINAGE.

The subject of drainage is so well established in estate practice that there were few inquiries. Correspondence was mostly related to recommendations for deeper and more frequent drainage on soils likely to be improved by it. Interest was shown by inquirers in the system of double-bunding water drains to induce surface water to flow through rather than over the soil.

REPLANTING.

An increasing interest was shown in replanting schemes, it being generally realised that these do not involve merely the removal of old trees and the planting of budded rubber but often require expensive measures to recondition the soil stripped by wash and depleted of humus by exposure. In such programmes lies the only salvation of estates with large areas of old failing trees, since in a very short time acute competition will be felt from areas of young budded rubber planted and maintained in accordance with modern ideas. In most cases the financial stringency has prohibited work on a large scale, desirable though this might be in the long view. Thus the tendency is to use the delay to advantage by experimenting on small areas in order that future programme may be undertaken with confidence in more prosperous times. At the time of writing, the cost of replanting and reconditioning exhausted areas generally exceeds that of new budded plantings on virgin jungle soil.

In brief, the procedure followed must depend upon the reason for replanting. Many managers have found to their cost that merely to replant a soil that has deteriorated through neglect is to court

failure. Reconditioning measures recommended include dressing with wood ash from the old trees, periodic fertilising of the young rubber and the growth and digging in of several successive cover crops. Since in a number of ways the proximity of old mature rubber is likely to interfere with the normal growth and development of the young rubber, it is recommended that no areas smaller than 5 acres should be experimentally replanted if they are surrounded by mature trees.

FERTILISERS.

The period has been marked by appreciable reductions in retail prices, by an increasing familiarity on the part of planters with the varieties and properties of chemical manures and by extended facilities for the rapid supplying of orders. Keen interest was shown in a number of quarters in the possibilities of the fertiliser market in Malaya.

There were naturally inquiries as to alternative forms in which the general manurial treatments recommended could be applied, the discussion turning on the economic question. The Division was able to give assistance, by computing the value of fertilisers and mixtures offered for sale on the basis of the market value per unit of Nitrogen, Phosphate and Potash in Malaya at the time of inquiry.

The Manuring of Rubber.

In order to obtain some statistics on the present position in relation to the use of fertilisers on rubber estates, a questionnaire was prepared and circulated with the Quarterly Journal (Vol. 2 No. 2) approximately to 2000 estates. A summary of some of the information obtained is given in the following tables; a more complete report will be published later. It is suggested that where estates did not reply it was because no manures of any kind had been used and there was therefore nothing to report.

TABLE I.

Total replies received	...	174 cases
No manuring done	...	74 ..
Manuring attempted	...	100 ..
Replies rejected, or green manure only used	...	11 ..
Immature or untapped rubber manured	...	11 ..
Considerable yield increase	...	13 ..
Some yield increase	...	20 ..
Vegetative response only	...	26 ..
No response	...	17 ..
Depression of yield	...	2 ..

TABLE II.

(Figures are in percentage of cases within the group).

—	Con- siderable yield in- crease	Some yield increase	Vegeta- tive response only	No response	De- pressed yield
Classification of total cases ...	13	20	26	17	2
SOILS.					
Coastal Clays ...	—	15	14	12	50
Alluvial soils ...	8	25	26	30	50
White soils ...	17	10	14	12	—
Red soils ...	58	25	39	40	—
Yellow soils ...	17	25	7	6	—
CULTIVATION HISTORY.					
Previously cultivated ...	69	75	65	41	50
Planted from virgin jungle ...	23	20	31	53	50
Not stated ...	8	5	4	6	—
LIE OF LAND.					
Flat ...	15	40	42	41	50
Gently undulating ...	31	40	15	12	—
Undulating ...	23	15	23	18	50
Regular slope ...	31	5	20	19	—

—	Con- siderable yield in- crease	Some yield increase	Vegeta- tive response only	No response	De- pressed yield
MANURES USED.					
Sulphate of Ammonia only ...	62	41	52	37	50
Manures containing Nitrogen in some form; other fertilis- ing elements may be present ...	85	96	94	77	50

NOTE :—The figures in the last column are necessarily of little significance, since only two cases of depressed yield were reported.

The writer wishes to take this opportunity of thanking those who replied to this questionnaire and particularly those who, having much of interest to report, summarised their information so clearly.

The tables are self-explanatory. Table I gives the first classification of the replies into groups. The cases remaining where the manuring of mature rubber had been undertaken were divided into five classes according to the effect observed. Table II shows the percentage of each of the five classes of cases which fall into various categories indicating soil type, agricultural history of the soil, topography and manures applied.

Additions to our knowledge of the laws governing yield and growth response in the manuring of rubber are indicated in a joint publication by the Head of Division and the writer which will shortly be available. A number of instructive cases are also considered in detail. The paper in its initial form was given by the writer at the Second Inter-Departmental Agricultural Conference held in Kuala Lumpur towards the end of the year.

It is not possible to discuss the economic aspects of manuring in this report; the rather obvious point of balance is the price of rubber, considering the cost of fertilisers as now fairly stable. Profit or loss does not depend on percentage yield increase but on the actual number of pounds of extra rubber that can be gained per acre and the price this will fetch on the market.

In 1929 fertilisers containing potash were recommended on a considerable number of estates. In 1930 a few results became available. Applications of potash only were remarkably effective in one

case on an open sandy soil containing a high percentage of organic matter but showing a marked deficiency of potash on analysis. In other cases where nitrogen only showed little effect and potash alone gave practically no response, nitrogen and potash together gave gratifying results.

On theoretical grounds it was suspected that water soluble phosphates would be far less effective on the soil of many estates than finely ground phosphates of lime (from various sources) which are not water soluble. This is of interest since most of the unfavourable results obtained on rubber with phosphatic manures had been obtained with water-soluble forms. During the year some practical evidence has emerged tending to confirm this.

Work was continued on the study in the field of leaf abnormalities and discolorations that appear to indicate plant food deficiencies in the soil. Observations on untreated soil have been correlated in some cases with response to the appropriate manures and the results of soil analysis.

An interesting experiment was tried on the manuring of young rubber with Nitrophoska: the work was done as a demonstration in connection with the discussion of certain results obtained on an estate. In February, stumps freshly cut from seedlings were planted in the usual 2 ft. $\times$ 2 ft. $\times$ 2 ft. holes. Some were untreated, others had 3 ozs. and 6 ozs. respectively of Nitrophoska mixed with the soil in the planting holes. Eight months after planting records were taken. Average heights of "6 ozs." and "3 ozs." plants were 1.4 and 1.2 times, respectively, the average height of unmanured plants and they carried, respectively, 2.0 and 1.5 times the number of leaves. Manured plants also showed a considerably greater girth of the new shoot.

Experiment Station.

Results of the second series of height measurements on Block 6 were discussed by the Head of Division early in the year in a publication in the Quarterly Journal. During the year two further applications of manure have been made. Girth measurements have now been taken and results will shortly be published.

By the end of the year, randomised square budding was completed on Block 17 with the following 6 clones from the Experiment Station nurseries:—Tjirandjii I and XVI, A.V.R.O.S. 183, 185 and 50 and Glenshiel I. Final budding of all available stumps on Blocks 19 and 24 with clone B.D. 5 was also completed. Our thanks are due to the Plant Physiologist for undertaking this work.

On Block 24 during the latter part of the year the terraces were widened to 7 feet and re-made with well-beaten lip bunds.

Preparations were made for laying down a nine plot experiment to test the relative soil conservation merits of common cover plants.

At the time of writing, this work is completed. Nursery beds arranged to test the effect of fertiliser and shade on the growth of seedlings were laid down in Block 17.

The prolonged drought on the open sandy soil of the flat land gave to the cover crop experiments in Block 17 a severe check from which they are only now recovering. Their value has by no means been prejudiced.

In other respects the work on the Soils Division Blocks at the Experiment Station has been concerned with the regular observance of the programmes laid down when the experiments were started and with the ordinary maintenance work required. Pests and disease work is in the hands of our own field staff under the general direction of the Pathological Division.

During the year, numerous census records were taken of heights, dead, missing and diseased trees, buddable trees etc.

Meteorological.

In this branch of the work, necessary re-organisation has unavoidably entailed breaking the continuity of the records. For the purposes for which they were required for our own work this was of little importance. Since meteorological records would obviously be of more immediate practical value if taken at the Experiment Station, it was decided to remove the large rain gauge and the screen containing the hygrometer and maximum and minimum thermometers from the Institute to the Experiment Station.

During the latter half of the year other instruments were added to the meteorological station set up at the Experiment Station, including a wet and dry bulb thermograph, a microbarograph and a Campbell-Stokes sunshine recorder.

A two-bulb soil thermograph was set up at the Experiment Station to record the temperature of clean-weeded unshaded soil at depths of 2 inches and 8 inches.

During this year the Callendar Solar Radiation Recorder installed in the laboratory began to give a good deal of trouble as a consequence of the trying conditions of tropical service. With the assistance of the Survey Department Workshop and the experience acquired by the Head of Division and the writer, it was found possible to keep the instrument in working order, although this required considerable time and attention and affected the continuity of the records.

Analysis of Samples and Laboratory Investigation of Soils.

During the year 273 samples, chiefly soils, were submitted by estates. This shows a considerable reduction compared with the year

1929 when 406 samples were submitted. But whereas in 1929 it was only considered necessary to perform a complete analysis on 256 of the samples received, in 1930, 203 of the soil samples were so examined. There was every sign of a spread of a general knowledge of the particular utility and especially of the limitations of soil analysis. Consequently there was a gratifying diminution of the practice, so noticeable in previous years, of sending in soil samples without details of sampling method and with little or no general information concerning the area from which they were taken; and there was an encouraging adoption of the proper procedure—namely, to state the problem clearly and leave the Division to ask for soil samples if required. There was further unmistakable evidence that a large number of inquirers had made themselves acquainted with the general principles to be followed in taking soil samples.

Of the 273 samples received 11 samples of fertilisers or other material of real or suspected manurial value were appropriately examined. 206 samples of soil were submitted to mechanical analysis and 203 samples of soil were submitted to chemical analysis.

The method of mechanical analysis employed was the rapid hydrometer method based on the work of Bouyoucos, but 49 of the samples were also examined by the official pipette method with a view to obtaining further confirmation of the accuracy within the desired limits of the hydrometer method on a wide variety of soils. The findings in this respect were satisfactory.

The routine chemical work on samples submitted involved 1106 accurate determinations as against 774 last year, since for our own further information on the chemical and physical properties of Malayan rubber soils the samples were more completely examined than in previous years.

The wet and dry colour of a fresh soil sample is of importance to the investigator, and since these colours often undergo an irreversible change after prolonged storage in the dry state it was felt necessary to have some means of recording the colours. The method adopted is comparison with the plates in a published book of colour standards and is applied to all soil samples received.

A form of questionnaire was drawn up to be filled in by all estates submitting soil samples for analysis. It is designed to give in a condensed form a history of the area and a report of its present condition, both as regards the soil and the rubber growing on it. The information is of the greatest assistance in interpreting the results of analysis and in furnishing a mental picture to the writer of the report.

The mechanical analysis of a soil, apart from its academic interest, is of practical importance as furnishing information on its physical properties and as a basis of comparison in classification.

Consideration has been given to simpler methods which, although they give less precise information of the mineral skeleton on which the soil is built, are yet considered to give a more reliable picture of physical properties in the agricultural sense and to be a more rational basis of comparison in classification. They have, further, the advantage of needing far less time and apparatus. Mention should be made particularly of the "sticky point" method of Keen, on which work was done under Dr. Haines's direction and of the very similar "index of texture" method due to Hardy.

Time was again spent in the collection of published information on new proposed methods of soil examination and in their trial and modification. This is a continuation of work which it is hoped will soon result in the establishment of a new routine which will give results of far greater agricultural value than the conventional methods still in use. Essential points on which conventional analysis can give only vague or ambiguous information are potential fertility to a given crop and manurial requirements. Particular attention is paid to the chemical properties of the soil colloids, to permeability to air and water and to micro-biological reactions. The writer has been engaged in preliminary work on the methods of direct microscopic examination and progress has been made.

Attention has been paid to the soil profile, but chance exposures in deep drains, stream banks and road cuttings have hitherto been relied on. In his previous work on cocoa plantations, Mr. Akhurst employed profile pits dug before a visit. He has demonstrated the advantages of this method in Malaya and it has been now adopted as our standard practice. Preliminary observations go further towards confirming the writer's conviction that the available depth of friable soil of good moisture retaining capacity is one of the most important factors in determining the fertility of a given site in relation to rubber cultivation. This conviction is based on published work on forest trees by other authors, on theoretical grounds, and on personal observations by means of casual profiles and auger borings. The Division has now a considerable collection of soil samples from all parts of Malaya. In the dry and powdered form in which they are stored many fundamental properties remain unchanged, and where such properties are concerned they afford valuable material for research work. Thus Mr. Akhurst has already gone far with a survey of Malayan rubber soils in relation to the distribution of Manganese.

SPECTROGRAPHIC ANALYSIS.

This is a method of analysis by which a small quantity of a powder or solution is introduced into a high temperature flame, an electric arc or a powerful spark. The light emitted is characteristic of the elements present and is analysed by the spectrograph, the

analysis being recorded on a photographic plate after a short exposure.

By inspection and measurement of the plate the investigator can identify the elements present with certainty, whether or not their presence was previously suspected; by taking suitable precautions the quantities present can be estimated with an accuracy sufficient for most purposes.

In routine work of a standard character, the plates can be taken by a trained assistant and submitted for reading to the chemist. They constitute a permanent record: thus if the plate were properly taken the analysis need never be repeated if on a future occasion interest is felt in constituents other than those sought in the first analysis. The amount of material required is usually minute, and routine analyses are extremely rapid. These spectrographic methods are in use in a number of laboratories throughout the world though their application to agricultural and soil chemistry is somewhat of a novelty.

The spectrograph can detect by the technique described 69 elements out of a possible 84, the remaining 15 being either of no practical importance or easily identified and estimated by other means.

The necessary equipment has been installed and experience has been acquired in the application of the method to soil investigations.

The writer has devoted much time during the past year to the study of the most recent developments in this branch of physics in its application to chemistry. Much preliminary work has been required because the literature of the subject, being of such recent development, shows a paucity of technical detail. The advantages anticipated from the free use of spectrographic methods are so great that time spent in preparation must assuredly show a good return.

Spectrographic methods are peculiarly adapted also to the investigation of problems occupying the attention of the Chemical Division e.g. the effect of minute traces of certain metals on the properties of raw rubber. The amount of material available is generally minute—a tiny spot on the sheet or an area in contact with a wire or metal fastener. No ordinary laboratory methods would permit the qualitative and quantitative examination of such small portions of unusual metals. An investigation is in progress in co-operation with the Chemical Division.

ACCESSORY MINERALS.

“Accessory minerals” refers to those elements that are either necessary, in minute traces, for the normal growth of certain plants or which, when present in such small quantities, can greatly stimulate general growth or the production of certain characteristics. As an example, the effect of Manganese on the growth of tomatoes may be quoted.

Zinc has received much attention, both by earlier workers in Europe and of recent years by American workers who have noticed that legumes make exceptionally good growth on afforestation seedling beds dressed with zinc sulphate as a weed-killer. Owing to the importance of leguminous covers in this country it was thought worth while to make some investigation of this point for local conditions. An experiment with *Vigna* planted in pots of jungle soil under carefully controlled moisture conditions and dressed with various concentrations of zinc sulphate has been carried out with suitable controls and replications. The results showed that a certain optimum concentration of zinc sulphate gave a marked increase in growth and in nodule formation. Records of green and dry weights, and number and weights of nodules were kept. Publication of results is delayed pending analysis of the ash.

Sand Culture Work.

The purpose of the experiment attempted is the investigation of food deficiency symptoms in rubber with particular reference to leaf discoloration. Methods of diagnosing plant food deficiencies in soil with reference to the particular needs of the crop, by observing distinctive abnormalities in the foliage, are well established for certain crops. Certain generalisations have been applied to rubber and have received some confirmation. An important step in the investigation of deficiency symptoms in rubber would be the growth of young material in sand culture pots supplied respectively with nutrient solutions exhibiting various deficiencies. Three attempts were made to do this, using budded stumps for the sake of uniformity. In each case growth was a failure. Various schemes were tried after the first failure but it was finally evident that the shock of cutting the tap root to suit the available depth of sand was responsible. Instead of preparing much larger containers it was decided to establish basket plants selected for their uniformity and this was successfully accomplished. When preliminary results are available an experiment on a much larger scale is proposed. The Botanical Division has co-operated in this work.

A feature of such work is that large quantities of distilled water are required for watering. The writer therefore designed and had erected a suitable locally made still of large capacity.

Lectures.

One lecture on "Soil Conservation and the Effect of Cover Crops" was given before the Negri Sembilan Planters' Association by the Head of Division and three by the writer on "Rubber Soils and the Manuring of Rubber" before the Central Johore and Tampin

Branches of the Incorporated Society of Planters and a meeting of planters at the Kuantan club.

The writer also presented to the Second Inter-Departmental Agricultural Conference a paper summarising the knowledge of the Division to date in relation to the manuring of rubber.

Publications.

The following papers were published during the year by the Head of Division.

- (1) Block 6 Manuring Experiment, R.R.I. Experiment Station. Second Report. Quarterly Journal Vol. 2 No. 1.
- (2) Notes on Rainfall distribution. Ibid, Vol. 2 No. 1
- (3) Manuring of Rubber II, Technique of Plot Experimentation. Ibid, Vol. 2 No. 2.
- (4) Studies in the Physical Properties of Soil, V. The Hysteresis Effect in Capillary Properties, and the Modes of Moisture Distribution associated therewith. The Journal of Agricultural Science Vol. XX Part I, January 1930.

Conferences.

During his leave, the Head of Division attended, as delegate from the Institute, the Second Congress of the International Society of Soil Science, held on this occasion in Leningrad and Moscow.

General.

The Division is glad to express appreciation of the prompt and friendly assistance rendered in the preparation of special apparatus by the Officers in charge of the Workshops of the Posts and Telegraphs Department and the Survey Department.

The Division is also indebted to the Plant Physiologist for valuable assistance on several occasions during the year.

Mr. K. S. Pillai, Assistant Soils Chemist, was in charge of chemical analyses of soils until the middle of the year when this work was handed over to Mr. T. S. A. Iyer, Assistant Soils Chemist, after he had received training in methods, so that Mr. Pillai could undertake work of a more specialized character.

Mr. Raman, Laboratory Assistant, was also trained in the preparation of microscopic slides of soils and soil forming minerals, with a view to acquiring proficiency in this technique for projected investigations.

In conclusion, acknowledgement is made of the loyal support of the junior staff of the Division.

C. FALCONER FLINT,
Acting Head of Soils Division.

ANNUAL REPORT 1930.

BOTANICAL DIVISION.

PLANT PHYSIOLOGIST.

During the year under review the general development of the work in Plant Physiology has followed closely the programme outlined in the Annual Report for 1929.

The present report deals with the progress of work on:—

- I. The improvement of *Hevea* planting material by vegetative means.
- II. The study of the response of the tree to different methods of tapping.

The report is divided into two main sections. The first deals with the progress of experimental work, including field investigations on the Experiment Station at Sungei Buloh and on estates. The second portion of the report deals with advisory work relating to the subjects under investigation.

The general acceptance of the budding method in plantation practice has resulted in a large increase in the volume of advisory work on estates. In order to deal adequately with this important side of the work, it has been found necessary to curtail the development of certain lines of experimental work which are of less immediate practical importance.

Progress of Experimental Investigations.

I. VEGETATIVE PROPAGATION.

(1) *Selection of High Yielding trees on Estates with a view to the establishment of new clones.*

The selection of promising parent trees, commenced in October 1929, has been continued throughout the year, but it is to be regretted that, owing to staff reductions and the difficulty of providing adequate supervision, some estates have been obliged to discontinue the work of recording the yields of promising parent trees.

A summary of the records of some outstanding trees is given in Table I.

TABLE I.

Records of the Yields of Some Selected Parent Trees in 1930.

District	Ref. No.	Average Yield per tapping (gms.)		Ratio $\frac{B}{A}$	Yield of selected tree, lbs. per Annum 1930.
		(A) of the average tree in same task	(B) of the selected Tree		
SELANGOR.					
Kuala Lumpur	B. 21/5	14	133	9.5	46.8
	B. 21/36	22	225	10.2	79.2
		22	226	10.3	79.6
		27	261	9.7	91.9
		21	260	9.0	91.5
		29	306	10.6	107.7
Klang Coastal	B. 21/44	21	230	11.0	81.0
		22	296	13.5	104.2
		23	237	10.3	83.5
Ulu Langat	B. 29/49	35	407	11.6	143.3
Tanjong Malim	B. 21/17	22	209	9.5	73.6
		24	244	10.2	85.9
		28	305	10.9	107.4
PERAK.					
Lahat	B. 21/10	18	176	9.8	62.0
	B. 21/53	23	209	9.1	73.6
Batu Gajah	B. 21/16	27	444	16.4	156.3
JOHORE.					
North Central	B. 21/25	18	162	9.0	57.0
		20	206	10.3	72.5
		18	169	9.4	59.5
		24	241	10.0	84.9
KEDAH.					
Alor Star	B. 21/60	19	262	13.8	92.3
		20	281	14.0	98.9
		19	256	13.5	90.1
		23	208	9.0	73.2
		26	276	10.6	97.2
		26	272	10.5	95.8

Though the number of estates from which full records are available is small the estates are well distributed throughout the country and it seems very probable that some of the highest yielding trees known are represented in the present collection.

In December a beginning was made in the collection of budwood from the selected trees. Buddings from each parent tree are being established in a multiplication nursery to provide material for a preliminary study of the new clones and later to provide budwood for the establishment of the clone testing plot on the Experiment Station (Block 15).

(2) *Collection of Clones.*

Each year new clones reach the tapping stage and many show promise of excelling some of the earlier established clones that have been planted commercially to date. Whenever possible small quantities of budwood of promising new clones have been obtained and multiplication nurseries have been established.

The present collection comprises 72 clones established in Sumatra, Java and Malaya. The age of the clones, reckoned from the date of planting as budded stumps or the date of budding in the field, ranges from six to thirteen years.

In establishing this clone collection our general nursery, planted in late 1928 and early 1929, has been utilised (Experiment Station Block 4). As later extensions of the area under cultivation on the Experiment Station allow, the most desirable clones in the collection nurseries will be planted in large scale field trial plots. During the season 1931 small quantities of budwood of a number of the clones will be available for distribution.

(3) *Establishment of new clones from seedlings of known origin.*

Nursery tests carried out early in the year showed that it was possible to make the fullest use of valuable plants by carefully removing dormant buds from the more mature portions of a budded plant without actually cutting the whole shoot.

This method of multiplication by "disbudding" was also used successfully with selected illegitimate seedlings derived from good clones. Reference to a further important application of the method is made by the Geneticist who has utilised it to establish several series of buddings from seedlings resulting from controlled crossing experiments.

(4) *Comparative studies of growth and development of different clones.*

(a) *Comparison of the growth and development of nine clones under uniform conditions in the field.*

The planting of the first large scale Clone Trial Plot on the Experiment Station was described in the report for 1929 (Block 5). Throughout the year, monthly measurements of growth have been made, individual records of all trees being taken. Although the results have not yet been examined statistically, the plot averages and clone averages are summarised in Table II. Observations made on a large number of estates on which the same clones have been planted show very much the same relation between the clones.

TABLE II.

Summary of Growth Records (December 1930) of Nine Clones, planted as budded stumps in November 1929 on the R.R.I. Experiment Station, Block 5.

Plot	Clone AVROS. 152 A		Clone AVROS. 49 B		Clone Prang Besar 23 C		Clone Prang Besar 186 D		Clone Bodjong Datar 5 E		Clone Tjirandji I F		Clone Pilmoor A. 44 G		Clone Pilmoor B. 84 H		Clone AVROS. 50 J	
	No. of Plants	Average Growth (inches)	No. of Plants	Average Growth (inches)	No. of Plants	Average Growth (inches)	No. of Plants	Average Growth (inches)	No. of Plants	Average Growth (inches)	No. of Plants	Average Growth (inches)	No. of Plants	Average Growth (inches)	No. of Plants	Average Growth (inches)	No. of Plants	Average Growth (inches)
I	98	61.5	112	98.2	100	82.7	104	100.1	99	75.4	109	81.4	108	74.7	107	93.0	92	103.4
II	113	61.0	111	71.0	92	44.1	109	80.2	94	52.6	115	77.0	104	60.1	113	96.7	101	56.2
III	96	52.3	111	102.9	95	66.2	108	82.2	94	71.8	100	70.6	105	64.9	93	82.5	82	78.3
IV	105	48.7	111	78.2	93	44.6	93	58.7	100	53.7	93	58.5	98	54.0	82	70.0	89	50.7
Totals and Means	412	56.0	445	87.6	389	61.7	414	80.9	387	63.3	417	72.5	415	63.7	395	86.8	364	71.8

The records summarised above are only taken from buddings planted between November 21st and 29th, 1929. Supply plants are not included. The maximum number of trees possible for each clone is 484. The actual number of successful plants given for each clone may be taken as an indication of the comparative ease of establishment in planting with budded stumps under the conditions experienced at Sungai Buloh.

(b) *Comparison of the growth of different clones under nursery conditions.*

Records of growth of the large number of clones included in the general collection have been made at monthly intervals. Since the collection nurseries also contain the clones already planted in field trials, direct comparisons can be readily made between new clones and those already in general use. The study of new clones for distinctive botanical characters has yielded valuable information which will be extremely useful in the identification of material suspected of being wrongly labelled.

(c) *Influence of density of planting on growth of budded trees.*

A large scale field experiment designed to study the effects of density of planting has been laid down in Block 14. Buddings of clone A.V.R.O.S. 50 have been planted at densities of 48, 108, 120, 222, 302 and 436 plants per acre. Planting, with budded stumps was completed in December 12th, 1930 and since weather conditions have been very favourable the planting has been very successful. At the time of writing (February 1931) over 90 per cent of the plants are growing vigorously.

(d) *Growth of buddings of different clones and growth of seedling trees in mixed areas.*

In conjunction with the Soils Division budding of the plants in certain experimental blocks, primarily designed for work on soil problems, has been carried out. In Block 17 certain sections were planted in October 1929 with basket plants at 22 feet by 22 feet. Interplanting with seedling stumps was carried out in April 1930.

In Block 17A (10 acres) the basket plants have been budded with clones Tjirandji 1 and 16, Glenshiel Clone 1, A.V.R.O.S. Clones 183 and 185, and A.V.R.O.S. Clone 50 as the control or standard clone. The distribution of the clones has been arranged to give the maximum distance between two buddings of any single clone. In this area the relative growth of buddings and seedlings will be studied and later, methods for the control of development, so that even growth of buddings and seedlings may be obtained will also receive attention.

(e) *Growth of buddings of the same clone under different cultural conditions.*

Again in conjunction with the Soils Division plants in Blocks 19 and 24 are being budded with a single clone namely clone Bodjong Datar No. 5. Since in these areas the main experimental work of the Soils Division concerning methods of soil conservation is in progress

valuable data on the effects of different methods of cultivation will be obtained from growth studies on the budded trees.

5. *Experiments on Estates.*

(a) *Changkat Kinding Estate.* In a mixed area of buddings and seedlings the growth of buddings of Clones A.V.R.O.S. 152 and 49 and Pilmoor Clone A. 44 is being studied. The soil in the experimental area ranges from reconditioned mining land to a deep clay loam on a small almost isolated hill and on the slopes of a wide ravine. Growth measurements have been made and a first thinning of interplanted seedlings has been carried out.

(b) *Gunong Kroh Estate, Perak.* Field experiments designed to compare the development of budded trees of a number of clones are in progress in

- (i) reconditioned areas surrounded by mature rubber and
- (ii) reclaimed swamp areas.

The scope of the original experiment has been extended by the manager of the estate to include a large number of the best known proved clones; buddings from new parent trees selected on the estate have also been introduced.

(c) *Lubok Segintah Estate, Kedah.* The growth of buddings of new clones, derived from selected parent trees on the estate is being studied. Comparison is made with buddings of a number of tested Malayan clones and "selected" seedlings.

The estate experiments described in (a), (b) and (c) were started in 1928 before it was possible to carry out similar work on the Experiment Station. The records obtained from these early experiments form a valuable supplement to those obtained on the Sungei Buloh Station.

(d) *Edinburgh Estate, Selangor.* In conjunction with an extensive scheme of replanting of old rubber areas in progress on Edinburgh Estate, a clone trial plot has been established. The organisation of the experiment is similar to that used in the Clone Trial Block on the Experiment Station. Six of the most promising clones have been planted in replicated plots each clone being represented by six plots of 100 trees each. The total area is approximately 40 acres.

In view of the increasing interest in replanting problems, the experiment in progress on Edinburgh Estate will prove extremely valuable. We are fortunate in obtaining this excellent opportunity to test the value of different clones for use in replanting work especially as the same clones are being studied on virgin land on the

Experiment Station which is only a few miles away from Edinburgh Estate.

6. *The mutual relationship between stock and scion.*

(a) *Laboratory Investigations.* Due to vacancies on the staff of the Division and the increase in advisory activities, purely laboratory investigations have been curtailed to a considerable extent. Work on the physiological anatomy of the region of union in buddings has not advanced but an investigation of the latex vessel systems in stock and scion has given interesting results.

This investigation has been carried on by Mr. K. N. Kaimal, who has worked with bark samples taken from budded trees of the promising young clones on Pilmoor Estate. A brief summary of the results obtained is given in Table III.

TABLE III.
Comparison of the Latex Vessel Systems in the Bark of Stock and Scion of 5 years old Buddings.

Clone	No. of Trees Examined	Mean Girth Dec. 1929 in inches	Bark thickness in millimeters				Latex vessel rows at				Average Yield in Gins. per tapping 1929.
			1 in. below Union	1 in. above Union	20 ins. above Union	40 ins. above Union	1 in. below Union	1 in. above Union	20 ins. above Union	40 ins. above Union	
A. 44	71	19.2	6.4	6.0	5.3	5.8	27.9	18.3	17.7	18.4	16.3
B. 58	21	19.9	5.8	5.5	5.7	5.7	21.1	20.4	22.1	20.8	14.9
B. 84	32	22.6	5.9	6.3	6.4	6.2	21.2	18.6	18.1	16.8	18.1
B. 16	42	19.8	6.2	7.2	6.6	6.6	22.1	18.8	18.6	17.0	15.8
D. 61	16	19.9	6.0	5.7	5.6	5.5	26.9	24.4	23.8	22.5	15.1
D. 65	5	22.0	7.1	6.6	5.8	6.2	28.0	17.4	15.6	15.8	12.9

The figures summarised in Table III show:

1. Relative uniformity in the thickness of the bark and number of latex vessel rows in the bark of the scion in all clones.
2. The relation between the number of latex vessel rows in the bark above and below the union varies considerably for different clones. (The detailed figures, not given here, show the relationship between latex vessel rows in scion and stock to be relatively constant for a single clone).
3. There is no close relationship between the yields of the different clones and the development of their individual latex vessel systems as indicated by number of latex vessel rows in the bark. The full data will be discussed in a separate publication.

- (b) *Field Studies.* (i) Nurseries have been established on the Experiment Station and also on Pilmoor Estate with clone seed and small quantities of seed from isolated areas containing single clones. It is intended to test the value of seedlings of known origin for use as stocks.
- (ii) The raising of "twin" seedlings referred to in the 1929 report, has been continued on an extensive scale. Some 3,000 "twins" have been successfully prepared and planted in the new nurseries on the Experiment Station (Block 25). Further experiment has also shown that it is possible to produce four plants from a single seed.
- The plants obtained in this work will be used as seedling stocks for further study of stock and scion relationships. The seed used throughout has been carefully picked from budded trees of good clones.
- (iii) A supply of budwood of *Hevea spruceana* has been established. This species of *Hevea* is known to grow well under soil conditions which are unfavourable for growth.
- (iv) *Spruceana* appears to be tolerant of conditions of poor soil aeration, its natural habitat being the flood plains in the upper Amazon valley. The intention is to establish isolated seed gardens of *H. spruceana* alone and also mixed with *H. brasiliensis* and to test the value of both pure and hybrid seedlings as stocks for budding with *H. brasiliensis*. *Hevea spruceana* can be budded very successfully on *H. brasiliensis*. From 3 yards of budwood we obtained 96 vigorous young buddings.

II. TAPPING EXPERIMENTS ON BUDDED TREES.

(1) *Pilmoor Estate.*

The tapping experiments on the clones established on Pilmoor Estate in November—December 1924, described in the Annual Report for 1929, have been continued under the supervision of Mr. F. Billington. All trees were rested from January 31st to April 31st. Tapping was resumed on May 1st and a brief summary of the results to December 31st is presented in Table IV.

TABLE IV.

Yields of the Pilmoor Clones May to December 31st 1930.

Clone.	GROUP A. Tapped Alternate Daily			GROUP B. Tapped Daily in Alternate Months		
	No. of Trees	Mean Girth at 1 meter in cms.	Mean Yield per tapping (gms.)	No. of Trees	Mean Girth at 1 meter in cms.	Mean Yield per tapping (gms.)
A. 44	54	53.1	18.7	54	52.6	18.7
B. 84	17	61.0	20.1	18	62.0	23.0
B. 58	34	51.8	20.3	35	50.0	19.4
B. 16	38	52.1	24.7	37	54.6	23.0
D. 61	13	49.3	18.0	12	51.1	17.5
D. 65	4	67.3	31.1	—	—	—

Tapping was recommenced on the same panel as in 1929 on a $\frac{1}{2}$ circumference left to right spiral cut at 35° .

All clones show a satisfactory increase in yield. The production of Clone D.65 has risen from 13 grams to 30 grams. per tapping.

The production of Clone B.84 is still significantly better on the daily alternate monthly system than on the alternate daily system. For other clones the differences in yield on the two systems are not significant.

STATISTICAL EXAMINATION OF YIELD RECORDS.

The figures for yield, girth and latex vessel rows obtained during 1929 have been examined statistically during the year.

Very high degrees of correlation between yield and girth and between the number of productive latex vessel rows and yield have been found.

TABLE V.

Relationship between :

- (1) Girth and yield
- (2) Productive latex vessel rows and yield on 5 year old budded trees of a number of Clones.

Clone	Correlation Coefficient Girth and Yield	Correlation Coefficient Yield and No. of LV Rows
A. 44	+ 0.86 $\pm$ 0.02	+ 0.77 $\pm$ 0.05
B. 84	+ 0.90 $\pm$ 0.05	+ 0.94 $\pm$ 0.02
B. 58	+ 0.74 $\pm$ 0.05	+ 0.85 $\pm$ 0.06
B. 16	+ 0.87 $\pm$ 0.03	+ 0.90 $\pm$ 0.02
D. 61	+ 0.81 $\pm$ 0.06	+ 0.61 $\pm$ 0.12
* Seedlings	+ 0.58 $\pm$ 0.04	+ 0.46 $\pm$ 0.04

* Bryce, G. and Gadd, C.H. Department of Agriculture, Ceylon, Bulletin No. 35. 1924.

The results summarised above confirm the claims made by earlier workers who have been obliged to base their findings on small numbers of trees. The corresponding relationships in a group of illegitimate seedlings derived from a single parent tree are given for comparison.

The practical significance of the results lies in their application to thinning-out operations. For all practical purposes the relationship between girth and yield within a clone is so close, that thinning can be based on girth measurements and laborious and expensive test tapping and recording may be dispensed with.

(2) *Sungei Way Estate.* The tapping experiments in progress on budded trees on Sungei Way Estate during 1929 were discontinued. Examination of the records for the complete test tapping year failed to reveal the presence of any clones of outstanding merit in this experimental area.

(3) *Glenshiel Estate.* During October and November 1921 an area of 140 acres of one year old seedling rubber was budded on Glenshiel Estate with material taken from selected high yielding

parent trees. In a section of this area, some 200 trees have been identified as members of the same clone.

The whole area was test-tapped in February—March 1927 and has been in normal commercial tapping from January 1928 to June 1929.

After six months' rest, tapping was recommenced in January 1930 when, at the request of the Estate, the trees were inspected and a scheme for experimental tapping and testing of the best clone was drawn up. After tapping had been in progress for five months on the normal alternate day system the trees were carefully divided as equally as possible into several groups each group consisting of 20 trees. The tapping systems tested with the results obtained during the year are summarised in Table VI below.

TABLE VI.
Summary of the Results of Tapping Experiments on Clone Glenshiel 1 from January 1st to December 31st, 1930.

Group	No. of Trees	System of Tapping	Average girth at height of 1 metre in cms.	Yield in grams per tree per tapping												Mean per tree grams per tapping	Yield expressed as percentage of Group I Control = 100
				Jan	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.		
I	20	Tapped alternate daily	82.9	80.6	63.5	45.8	63.9	72.1	78.0	62.6	61.0	64.5	64.5	58.9	57.9	64.4	100.0
I-A	20	As I. But tapped on the days when I is resting	80.1									69.4	65.6	60.4	63.5	64.7	105.2
II	20	Tapped daily in alternate months	82.9						77.0	—	59.2	—	64.4	—	67.4	67.0	104.9
III	20	Tapped daily in alternate fortnights	85.1						74.5	55.0	61.5	64.0	70.8	60.1	68.9	65.0	101.7
IV	20	'Heusser system' 2 cuts (3), alternate daily	82.6						65.0	62.0	60.1	68.1	73.4	69.6	69.8	66.9	104.7
V	20	Alternate daily on $\frac{1}{3}$ cut	83.6										55.1	55.9	55.0	55.0	91.6
VI	20	Daily alternate $\frac{1}{3}$ monthly	83.6										42.3	43.6	49.2	45.0	74.5

Tapping was commenced in January, 1930, for all trees in Groups I to VI. Trees were opened at 40 inches from the union with a left to right spiral cut over $\frac{1}{2}$ the circumference on Jan. 1st, 1930. Until May 31st tapping was alternate daily for all trees and the figures given for Group I for January to May may be regarded as representative for the whole clone. From June 1st the study of different tapping periods has been in progress, tapping being continued on the same panel except in Groups IV, V and VI where the necessary adjustments have been made.

The differences between the results obtained under different tapping systems are not pronounced so far but there are definite indications that the daily alternate monthly system is likely to prove the most favourable one for this clone. Apart from the assistance given by the Botanical Division in the planning of these experiments the whole of the detailed work of recording individual yields has been carried out on the estate. We are especially indebted to Mr. J. H. H. Bailie and Mr. W. A. D. Wynch for the great interest shown in these experiments and the care with which detailed records have been made.

Advisory Work.

Since the main problems that arise in connection with budding and tapping operations are physiological, numerous enquiries have been dealt with during the year. Only by personal visits to estates is it possible to deal satisfactorily with certain problems and 80 estates have been visited in connection with budding and tapping work. Other enquiries require laboratory investigations but a large proportion of the enquiries received have been satisfactorily treated by correspondence.

SUMMARY OF WRITTEN ENQUIRIES.

Budding			
Estate enquiries	...	...	342
Enquiries from Agencies and Individuals		...	88
Purchases and Exchange of Material	...	...	54
Selection of Parent trees	...	...	221
Tapping			
Tapping of budded trees	...	...	61
Tapping of seedling trees		...	32
General enquiries	...	...	95
Total			893

During 1930 there has been a very marked increase in the number of visits from estate managers and assistant managers to discuss their problems either at the Laboratories or on the Experiment Station. Including visitors from other experimental stations and representatives of estates in Malaya, 122 visitors came to the Division to discuss various aspects of budding and tapping work.

BUDDING.

It has been the aim in the following sections to treat the subjects of enquiry in the order of their importance as indicated by the correspondence figures and the number of special visits entailed.

(a) *Choice of Clones*: So many clones of merit are now available for commercial planting that it is often difficult for estate managers, who may be isolated from reliable sources of information to decide upon the best clones for their purpose. In order to be in a position to supply detailed reliable information careful notes have been compiled concerning all the important clones available. These notes have been amplified by actual observations on the original trees in Sumatra, Java and Malaya. In the collection of the necessary information we are indebted to the officers of the A.V.R.O.S. Station in Sumatra and the Proefstation voor Rubber, Buitenzorg, Java as well as to the Managers and Directors of a number of estates in this country.

The most important clones that have been generally recommended for planting during the year are:

A.V.R.O.S. Clones 49, 50, 152 and 256:

Prang Besar Clones 23, 86, 123 and 186:

Bodjong Datar Clones B.D. 5 and 10:

Tjirandji Clones 1 and 16:

Sungei Reko Clone 9.

Towards the end of the year the promising new Malayan clones Glenshiel 1, Sabrang 24 and Rubana 393 have also been included in the list.

For propagation in the nursery for later use in the field the newer A.V.R.O.S. Clones 183, 185, 209 and 214 have been recommended.

(b) *Schemes of Planting for Buddings of different Clones*: There is still considerable divergence of opinion as to the best policy to adopt in establishing budded areas. Enquiries on this aspect of budding work have therefore been numerous.

Advice cannot be stereotyped and each case must be considered separately. The policy to be adopted is largely dependent on the choice of clones.

(1) When the choice is confined to the clones that have been carefully tested over a period of five years or more and the records are satisfactory in all essentials then block or monoclonal planting is generally recommended.

(2) As many younger clones are now known that show promise of better performance than some of the older established clones there is a natural desire to utilise newer material if possible. In this connection mixed planting of a number of clones, usually

not less than five, is advised. Clones selected for planting on this system should have been under test for at least three years.

(3) A further system of planting clones which combines to some extent the advantages of (1) and (2) has also been recommended. Alternate trees are buddings of one of the oldest and most "safe" clones; intermediate trees are buddings of a very promising, but as yet insufficiently tested, newer clone. Thinning will be determined by the subsequent history of the two clones so that eventually a pure planting of the better clone may be obtained if desired.

The density of planting recommended under the above systems is (a) for monoclonal or block planting 120-130 trees per acre, (b) for mixed planting (2 and 3) 150-200 trees per acre depending on the type and number of clones to be used.

Planting of buddings of clones which have been tested for a period of less than three years is not as a rule recommended. Experience has shown that a number of clones planted on the strength of early promising records have developed undesirable characters early in their life. It is preferable to establish multiplication nurseries for young clones and to delay field planting until it is reasonably certain that serious defects are hardly likely to develop.

(c) *Technique of Budding Operations*: Assistance has been given to estates in the training of labourers in budding work as in previous years. Conductors have been sent to 24 estates and skilled Chinese and Tamils budders have also been loaned to 17 estates. With the completion of the Hostel on the Experiment Station it has been possible this season to accommodate conductors from outside estates who have been given instruction on the Station. In January a short course of instruction was given to Malay Agricultural students from the Department of Agriculture, S.S. & F.M.S.

Written enquiries on technique have been less numerous than in 1929 and this is possibly due to the fact that many estates having small budding programmes prefer to engage experienced labour for their work rather than to train new men on the estate.

(d) *Care of Young Budded Trees*: Advice has been given on special aspects of pruning young budded trees. During 1929 a considerable acreage of young seedling rubber from $1\frac{1}{2}$ to $2\frac{1}{2}$ years of age was budded in the field. Occasional losses of young buddings due to decay and fungus penetration at the exposed surface of the stock have caused alarm. In budding large stocks special care is necessary during the later stages of healing over at the union. After final pruning, when all dead tissue is removed, it is advised that the pruning cut be treated with an Asphalt-kerosene mixture made up in the proportion of 2 parts of asphalt to 1 part of kerosene. This pro-

tective covering should be inspected at frequent intervals and, when cracks are noted, the dressing should be renewed. Periodic inspection should be continued until the new callus and bark have completely covered the cut surface of the stock.

Buddings made on strong stocks have suffered severely from wind damage in the very early stages of growth. Special methods for the protection of buddings under these conditions have been tested and advised.

TAPPING.

(a) *Tapping of Budded Trees*: Apart from the experimental work in progress on Pilmoor Estate and Glenshiel Estate, six other estates possessing budded trees of tappable age, have been visited. As far as possible advice and assistance have been given in regard to the tapping and testing of new clones.

Advice has been based on the experience gained from the tapping work in progress on Pilmoor Estate and also on the published work of other investigators in Sumatra and Java.

Young budded trees of untested clones are generally considered to be ready for test tapping when the girth at a height of 40 inches from the union is not less than 15 inches. Test tapping is carried out on a half circumference left to right spiral cut at an average slope of 30°. During the first year alternate day tapping in alternate months is advised giving approximately 100 tapplings over the whole year. After a rest of six months the cuts are re-opened and normal alternate day tapping is continued on the same tapping panel. If the number of trees in a clone is sufficient, daily tapping in the alternate months is also carried out.

It is usually found that normal tapping can be undertaken from 5 to 5½ years after budding.

During the test tapping period and the first year of normal tapping it is considered advisable to record trees individually. Individual tree records are often extremely valuable in checking clone purity and they also provide a ready means of selecting a truly representative group of from 10 to 20 trees of each clone for future recording.

(b) *Tapping of Seedling Trees*: The most important enquiries on the tapping of ordinary seedlings have concerned the so-called "A.B.C." tapping system. For economic reasons a large number of estates have adopted this system and the probable influence of the change on total production has formed the subject of the majority of enquiries.

Where records extending over a period of at least three years are available the results appear to be very conflicting. Much

more work requires to be done before definite advice can be given on the subject.

PUBLICATIONS AND LECTURES.

An illustrated manual on "Budding of Rubber" was prepared for translation into the Chinese and Malay languages.

(Chinese Vernacular Journal, Department of Agriculture, S.S. & F.M.S., Vol. 4, No. 2, 1930.)

(Malay Vernacular Journal, Department of Agriculture, S.S. & F.M.S., Vol. 8, No. 2, 1930.)

Three lectures on various aspects of budding work were given during the year as follows:

- | | | |
|-----|-----------------------------------|---------------------|
| (1) | Incorporated Society of Planters, | Telok Anson Branch, |
| (2) | do. | Tampin Branch, |
| (3) | do. | Sitiawan Branch, |

EXHIBITIONS.

In connection with the Malayan Agri-Horticultural Association Show in Kuala Lumpur from April 19th to 21st an exhibit illustrating budding work was arranged. Demonstrations of the budding operation were given daily by Malay, Indian and Chinese demonstrators. Informal lectures were given daily to parties organised by the Field Officers of the Department of Agriculture.

CONFERENCES.

A paper on "The Application of Budding of Hevea to Kampong Conditions" was read at the Inter-Departmental Agricultural Conference held in October, 1930.

SPECIAL VISIT.

In June, a special visit to Sumatra was undertaken and a most interesting and instructive tour of visits was carried out. Sincere thanks are due to Dr. A. d'Angremond, Dr. C. Heusser and Mr. J. F. Schmöle of the General Experiment Station of the A.V.R.O.S., Mr. G. E. Coombs, Mr. J. Grantham and Mr. C. Barclay of the H.A.P.M. Estates and Research Department at Kisaran, Dr. P. Arens and Dr. F. Arens of the R.C.M.A. Research Staff at Klein Soengei Karang, Mr. H. J. V. S. Holder and Mr. R. W. Hester of Boekit Maradja Estate, Dr. J. R. Weir and Mr. N. C. Bangham of the Goodyear Plantations Research Department at Dolok

Merangir, for the privilege of seeing and discussing important experimental work in progress and also for their generous hospitality.

GENERAL.

Though laboratory work still takes a very important place in the year's activities the work on the Experiment Station has shown a large increase in volume and importance. The ready assistance and careful attention given by the Manager of the Experiment Station to the control of field work on experimental blocks is much appreciated.

The increasing interest and ability shown by the members of the junior staff in their special duties is recorded with satisfaction.

C. E. T. MANN,
Plant Physiologist.

ANNUAL REPORT 1930.

BOTANICAL DIVISION.

GENETICIST.

During 1930 the work of the Division was carried out on the same three lines as before—breeding and the parallel study of variation, vegetative propagation and tapping.

Variation.

Little work was done on variation in leaf and seed shape. Further measurements of the leaves of trees and clones previously studied were left over to future years and a few new clones only were examined.

The work of sorting the Sungei Way Estate clones was continued on the best clones with the object of finding all trees of the clones so that the true mean yield could be determined. Previously attention had been concentrated on the best trees. Further assistance was also given to another estate with an area of mixed buddings from which the best trees had been picked out by test tapping.

The study of buddings of the best known clones was continued on the Institute Experiment Station and on estates, and by the courtesy of the Director of the Central Rubber Experiment Station at Buitenzorg and of several estate managers, the most famous Java clones were examined on their parent estates. As a result notes and sketches of typical characters of sixteen clones were compiled and duplicated copies are available for those interested. It is intended to revise and add to these as opportunity offers.

The work on twin seedlings was carried further and numerous twins were obtained for stock experiments on buddings. The final success of established twins was from 80 to 90 per cent. of the seedlings treated. Large seeds gave the best results, presumably owing to their greater reserves of food substances. Periodical records of growth were taken.

Selection and Breeding.

As described in the last report systematic records have been kept of the yields of trees on a number of estates.

Unfortunately in 1930 seed was scarce and much of it was imperfectly developed and non viable. Consequently from eighteen estates, which had promised assistance, seed was obtained only from

forty two trees on eleven estates, and finally only twenty trees from seven estates gave groups of seedlings sufficiently large for inclusion in the family trial. These are growing in nurseries at the Institute and will be planted out as stumps in Block 25 at the Experiment Station.

Our thanks are due to the managers of these estates for their trouble in searching for seed, and for sending the fruits to the Institute.

Circulars were sent to agencies and estates for the collection of information relating to the sale of selected seed. There was relatively little activity in this direction but it is gratifying to notice the tendency to advertise seed from high yielding individual trees rather than from areas.

Pollination was again carried out in both flowering seasons on the budded trees at Pilmoor Estate. A visit was made to Lunderston Estate in September but no female flowers were found on the best clones. A few twigs of male flowers were however brought back and used with some success the next day on one of two clones at Pilmoor.

A visit was also paid to Sungei Tinggi Estate. Flowering was too poor to permit of pollination on any scale but methods were discussed with the Agriculturist of the Socfin Co., Ltd.

In 1930 the flowering seasons were more clear cut than in 1929, and pollination was possible only from 24th February to 19th May and again from 25th August to 14th October. Unfortunately the combined effects of drought and disease caused much shedding of flowers and young fruit, and the average success was low. In 1928 and 1929 about half of the young fruits set remained on the tree and ripened. In 1930 only about one-third survived.

Altogether ten Pilmoor clones were crossed in twenty one combinations and two were selfed.

In addition Pilmoor clones B 84 and B 16 were pollinated with Lunderston clone B. This makes to date a total of sixty three combinations of fourteen Pilmoor clones and three combinations with Lunderston clones. Of the thirty six possible combinations (including selfs and reciprocal crosses) between the six best Pilmoor clones thirty two have now been made.

The following table gives a summary of the pollinations and the success. The second season's figures are not final and represent the last count in December, when most of the fruits had reached full size and should be expected to ripen successfully.

Season.			Flowers.	Fruit.	Percentage of success.
First	Crosses	...	1,282	69	5.4
	Selfs	...	679	7	1.0
Second Crosses		...	1,344	79	5.9
Total		...	3,305	145	4.5

A number of pollinations were also carried out by two Asiatic assistants under supervision and fourteen fruits were obtained from 703 flowers of nine different crosses.

Observations on the condition of the flowers, time, temperature and air humidity were continued for comparison with the previous years' results.

In view of the results of 1929 all flowers were protected by muslin bags and the plugging method was not used.

When the previous report was written not all the 1929 fruit were ripe. These were picked later and the seedlings planted out in groups in Block 16 at the Experiment Station. The total number of fruit from 1929 crosses and selfs was 314 and from these 736 seedlings were obtained.

Part of Block 25 at the Experiment Station is allotted to the 1930 crosses and one hundred and eighty nine seedlings from the first season have already been planted.

Preliminary experiments were started on the germination of Hevea pollen in sugar agar. Sucrose, glucose, levulose, and galactose were tried, and the best results were obtained with about 15 or 20 per cent. of sucrose. The results varied however, and though clone differences were suggested no final decisions were reached.

In November the 1928 crossed seedlings in Block 4 A at the Experiment Station which were big enough, had six or so buds taken from them, and these were budded in the field in Block 3 in rows of six plants with one plant of AVROS 50 in ten or twelve for comparison. Thus 185 new clones have been established which should be ready for test tapping nearly as soon as their mother trees.

Experiment Station.

Most of the work carried out on the Experiment Station has been referred to in previous sections, but it is summarised here in the order of the Block number.

Block 2.—Three-monthly measurements of girth at 0, 50 and 100 cms. from the ground were started when the seedlings were becoming too tall for height measurements. The last measurements of height and the first of girth were taken at the same time and a high correlation ($r = 0.85$ approx.) was found between them.

Block 3. All suitable plants were budded from the crossed seedlings in Block 4.

Block 4 A. Measurements of height and later of girth at two months intervals were continued.

Buds were cut from 185 of the 1928 crosses for use in Block 3. The surplus were put on in the nursery and the stumps will be transferred to part of the neighbouring Block 25.

Block 4 C. The remainder of this Block has been planted with twin seedlings.

Block 16. The planting of this block was completed. It contains groups of individual mother tree seedlings, the 1929 crossed seedlings, buddings and ordinary seedlings from the parent clones, and also supply stumps from 'selected seed' of three estates.

Two-monthly measurements of height were taken, and at the end of the year girth measurements were started on the bigger groups.

Germination and Vitality.

Experiments were continued on the retention of vitality of seeds, methods of packing, and the preparation of seed beds. Unfortunately the shortage of good seed prevented the repetition of these experiments on a larger scale, and publication of detailed results will be reserved until this is possible.

Germination beds were laid down with top layers of river sand, ordinary soil and jungle soil, and sand was found to give the best results. This agrees with the experiments of van der Hoop in Java (*Archief v.d. Rubbercultuur* 14. 2. Feb. 1930).

The influence of the position of the seed was also studied and the results obtained were similar to those of Petch (*Circular of Roy: Bot. Gard. Ceylon*, 1909) and of Sprecher (*Bull. Bot. Gard. Buitenzorg* 2nd serie XIX, 1915). The best position is horizontal, for though the germination rate and percentage is not very different, seeds with the germ pore upwards give a high percentage of twisted shoots.

Experiments with methods of improving germination by removal of the lid of the germ pore, cracking and soaking were not as conclusive as those mentioned in the 1928 report and must be repeated.

It was shown that seeds packed with powdered wood charcoal in tins retained their vitality almost unimpaired for one or two months if the charcoal contained from 20 to 30 per cent. of added moisture.

With 10 per cent. of moisture and even with dry charcoal a considerable percentage of seeds still germinated.

Further experiments are necessary to determine the optimum percentage of moisture in the charcoal for successful germination of seeds and to study storage for longer periods.

All seeds were obtained from hand picked fruits which were allowed to open in the sun after collection.

Our thanks are due to the Director of the Socfin Co., Ltd., for permission to collect from Bungsar Estate the seeds used in these experiments.

Cover Plants.

During the year fifteen specimens of introduced and indigenous cover plants were received for identification and advice. Instructions for sending such material were published in the Quarterly Journal Vol. 2 No. 1.

A number of enquiries concerning *Momordica charantia* (a cover plant recommended in Java), and a supply of seed for experiment were passed on to the Field Division.

The *Desmodium* species in Block 4C suffered badly from the continued drought but recovered somewhat with the advent of rains. At the edges of the block where *Calapogonium*, *Centrosema* and *Vigna* were spreading the *Desmodium* received some shade and continued to grow well. Several good patches of *Hydrocotyle asiatica* have become established in the same block.

A particularly interesting estate in Pahang with stiff clayey hills was visited. Natural covers and belukar and even rubber seedlings are allowed to grow, though the manager dislikes and cuts out certain hard stemmed types of plants, which do not rot easily. The condition of the soil under this growth is remarkably good and the rubber is growing well. It is hoped that further observations will be carried out in conjunction with other Divisions.

A collection of the most abundant plants was made and 27 species of flowering plants and 8 of ferns, etc. were identified, some with the valuable help of the staff of the Botanic Gardens, Singapore.

Apart from these plants the herbarium collection has been extended and now comprises 91 species of flowering plants, and 10 ferns and allies. Particular attention has been paid to the flora of the Experiment Station at Sungei Buloh and 38 species have been collected.

Publications and Lectures.

During the year lectures were given on 'Selection Problems' to the Central Perak Planters' Association at Ipoh, and on 'Seed Germi-

nation' to the Central Johore branch of the Incorporated Society of Planters at Rengam.

General.

In January the Geneticist went to Java on local leave and visited the Central Proefstation voor Rubber and the Cultuurtuin at Buitenzorg, Tjirandji, Bodjong Datar and Pasir Waringin Estates and also the estates of the Pamanoekan and Tjiassem Landen—including Wangoeredja and the Tjikadoe and other seed gardens. Thanks are due especially to Dr. de Vries, Messrs. Ostendorf and Ramaer of the Proefstation and Mr. Jackson and Mr. van der Hoop of the Anglo-Dutch Co. for very interesting visits and discussions and hospitality.

It is a pleasure again to record our thanks to the managers and assistants on the estates on which experiments and observations and collections of material have been carried out.

The thanks of the research staff are also due to the members of the junior staff for their assistance in the labour of routine observations in the laboratory and in the field.

L. E. MORRIS,

Geneticist.

ANNUAL REPORT 1930.

PATHOLOGICAL DIVISION.

Research Investigations.

The principal investigations carried out or completed during the year are indicated in the list of experiments conducted at the Experiment Station and in the publications listed at the end of the report.

FIELD INVESTIGATIONS ON ROOT DISEASES.

In addition to the experimental work carried out at the Experiment Station, an important and extended field investigation has been carried out and completed early in 1931 in relation to the incidence of root diseases in mature rubber of various age classes. A report on this work has been submitted and will be published later.

FUNGICIDES.

Arrangements have been made in collaboration with the Department of Agriculture to commence an investigation on the value of various proprietary and other fungicides for the treatment of Mouldy Rot, with a view to the preparation of a "White list" to include only those products which have been thoroughly tested and approved by this Institute. It is hoped to commence this work during 1931.

Root Diseases.

FOMES LIGNOSUS AND FOMES PSEUDOFERREUS.

The two most important root diseases viz *Fomes lignosus* and *Fomes pseudoferreus* have been the subject of investigation during the year. The former has been very prevalent on the Experiment Station at Sungei Buloh and a considerable number of preparations have been and are still being tried to control it. The results of this work are not yet completed, but there would appear to be possibilities in some of the materials tried. Both these root diseases have been the subject of many communications and there can be little doubt that the latter species tends more and more to become the limiting factor in old rubber areas.

It is largely on account of this fungus—*Fomes pseudoferreus*—that in many cases, owing to reduction of stand and decrease in crop, replanting programmes for old rubber areas will have to be considered in the not very distant future.

Treatment as carried out in the past has not had the desired effect in many cases. Investigations now in progress demonstrate clearly that *Fomes pseudoferreus* may be present in a very active state in 6 year old rubber and unless control is established early it merely increases in effect year by year. Early control of root disease is essential and though somewhat expensive initially is cheapest in the long run.

Stem and Branch Diseases.

PINK DISEASE.

Pink Disease (*Corticium salmonicolor*) shows little change as to areas or intensity of attack compared with preceding years. The method of control of this disease is now well understood and is usually put into effect in good time. Pollarding trees is usually avoided which indicates that treatment is applied early.

USTULINA ZONATA.

Ustulina Zonata still takes heavy toll as a branch disease following careless pruning, wind-breaks or other wounds. This disease—as a collar rot—has occurred several times in areas subject to flooding.

WHITE THREAD BLIGHT.

A few cases of White Thread Blight have been noted from districts widely separated.

Leaf Diseases.

OIDIUM HEVEAE

By far the most important leaf disease has been the Oidium leaf disease causing a secondary Leaf-fall. The long dry period in 1930 from about February to August proved to be particularly favourable for the rapid spread of this disease. The effects were particularly severe in parts of Malacca and Negri Sembilan. In some other districts the attack was most noticeable on the young inflorescences causing the flowers to fall to the ground in an immature stage. Mr. Beeley made a tour of the Malacca district from March 30th to April 6th and also visited North Johore and Southern Negri Sembilan to investigate this disease. A second visit was made to the same district from November 10th to 14th to note the conditions after the drought. The fact that the fungus was still present in an active condition during and after the rains suggests the possibility of further outbreaks given favourable conditions, during the wintering season of 1931.

An interesting fact observed in most of the affected areas was that where the attack early in the year had not been sufficiently severe to produce a secondary leaf-fall at the time, some months later a very severe leaf-fall occurred i.e. the full effects of the attack were merely delayed. A contributory factor was the prolonged drought.

OTHER LEAF DISEASES.

Other leaf diseases which assumed more importance than in previous years were Bird's Eye Spot due to *Helminthosporium Heveae* and leaf spot due to *Cercospora Heveae*. The latter was in many cases present on Oidium infected leaves which had been attacked at a comparatively late stage of development.

The attacks by *Helminthosporium Heveae* were in many cases markedly severe in nurseries and in a few cases in young clearings under 1½ years old. The long period of dry weather was no doubt a most important contributory factor. Leaf tip scorch followed by *Phyllosticta Heveae* attack was reported from a considerable number of districts. Dieback of young leaf tips immediately following a short period of rapid growth was a feature of certain areas of budded stocks. This, though perhaps a little more pronounced with certain clones, was by no means restricted to particular clones. The cause was primarily physiological and related to the long dry season experienced during the year.

Soon after the rains started in September rapidly developing young leaves frequently stuck together at the tips as they hung vertically downwards. This condition was the primary cause of a good deal of leaf dieback from the tips which turned black and shrivelled up. Usually the effect was restricted to a small part of the leaf.

As a preliminary to the investigation of leaf diseases in general a start has already been made in setting up pure cultures of the fungi found on diseased leaves.

Bark Diseases.

Bark diseases include Mouldy Rot of the tapped surface, Black Stripe and Patch Canker.

MOULDY ROT.

During the greater part of the year, until about the end of August, few reports of outbreaks of Mouldy Rot were received except from small holdings. Soon after the rains set in however quite a crop of cases were reported but these were adequately dealt with. So far as this disease is concerned there need be no particular

cause for anxiety if the necessary steps, which should be now well known, are taken promptly.

BLACK STRIPE.

Black Stripe has not been very prevalent but still persists in some areas where sporadic outbreaks have occurred for several years; it is usually quickly controlled.

PATCH CANKER.

Patch Canker has again been noted in districts previously affected and has appeared in one or two new areas but is well under control. There is some evidence that this disease tends to spread slowly.

BROWN BAST.

There has been a recrudescence of interest in the problem of Brown Bast and the isolation method is being tried in some areas. The measure of success is not known at present. Cases of long standing where a full panel is already affected are fairly frequent in older rubber areas.

INTERNAL FISSURES IN HEVEA CORTEX.

This feature of the cortex was fully investigated by the late Mr. Sutcliffe and a full account by him was published during the year. No fresh information is available at present but cases have been found in new areas, and in trees of different ages.

DIEBACK OF THE RENEWING CORTEX.

A good many cases were noted especially during the drought. These were due to drying out following too deep tapping or due to sun scorch. No new features were found.

During the wet period—September to December—a good many cases of Collybia on the tapping panel were noted. This when well developed somewhat resembles a bad Mouldy Rot attack but the bark does not die back. A single painting with a weak disinfectant is usually effective in preventing further development.

Insect Pests.

Several cases of caterpillars attacking the renewing cortex were reported during the year particularly during the dry weather; gener-

ally control was quickly established. Attacks on young areas by grasshoppers were fairly frequent but in no case apparently did these prove a serious pest.

ANIMAL PESTS.

For the first time on record a considerable number of cases were reported of squirrels destroying the renewing cortex. Investigation showed that in general the most severe attacks were on areas which had been rested for some time or on areas adjoining coconut plantations. Control was established by destroying the squirrels. In only a few cases was appreciable damage done in areas in tapping or which had not been rested for some time previously.

Rat damage has apparently not been nearly so bad as in previous years.

Experiment Station, Sungei Buloh.

A number of experiments as indicated below were carried out during the year at the Experiment Station.

1. Treatment of *Fomes lignosus* patches with various preparations proprietary and otherwise, so that supplying could be done within a period of 3 to 5 days.
2. Treatment of Collar attack of *Fomes lignosus* as in (1).
3. Experiments (small scale) on soil disinfection.
4. Large scale experiments with liming.
5. Large scale experiments with chemical manures.
6. Test spraying experiments (A report on these has been published in the Quarterly Journal Vol. 2 No. 4).
7. Experiments with wound covers as applied particularly to bud grafting have been completed. (A report on these has been published in the Quarterly Journal Vol. 2 No. 3).
8. Preliminary experiments on disinfection of budwood have been completed. (A report on these has been published in the Quarterly Journal Vol. 2 No. 4).
9. An account of growth under different conditions as regards cover plants, clean weeding etc., has been submitted for publication.
10. Two general surveys have been made of areas on which timber has been piled.
11. A scheme of inter planting rubber with coffee, pineapples and tapioca has been carried out in Block 23.

Advisory Work.

The following analysis of correspondence indicates the principal activities of the Division in relation to Advisory Work on diseases during the year.

In addition to the enquiries dealt with by correspondence, numerous visits were also paid to various estates.

Analysis of Correspondence.

Subjects.				Estates.	
				Letters received.	Letters despatched.
Root Diseases	...	...	...	94	130
Stem and Bark Diseases	...	...	...	87	104
Leaf Diseases	...	...	...	167	179
Fungi not proved pathogens of Hevea	...	...	...	6	7
Fungicides and Insecticides	...	...	...	54	69
Tree Operations	...	...	...	12	17
Floods	...	...	...	2	2
Injury by External Agents	...	...	...	102	123
Brown Bast	...	...	...	32	39
Epiphytes on Rubber Trees	...	...	...	2	2
Parasitic Phanerogams	...	...	...	4	4
Spraying and Dusting Equipment	...	...	...	12	16
Cover Plants	...	...	...	—	2
Miscellaneous	...	...	...	29	60
				603	754

Publications.

The following papers from the Pathological Division were published in the Quarterly Journal of the Institute during the year under review.

1. Brown Bast. Some Considerations as to its Nature by Edgar Rhodes. Quarterly Journal Vol. 2, No. 1.
2. Internal Fissures in Hevea Cortex by H. Sutcliffe. Quarterly Journal Vol. 2, No. 1.
3. Some Observations on Mildew Leaf Disease of *Hevea Brasiliensis* due to *Oidium Heveae* by A. R. Sanderson. Quarterly Journal Vol. 2, No. 1.

4. A Recent Outbreak of Secondary Leaf-fall due to *Oidium Heveae* by F. Beeley. Quarterly Journal Vol. 2, No. 1.
5. The Use of Asphalts and Bitumens on Estates (1) by H. Sutcliffe. Quarterly Journal Vol. 2, No. 3.
6. Notes on Recent Observations on *Oidium Heveae* by F. Beeley. Quarterly Journal Vol. 2, No. 3.
7. The Effects of certain Fungicides on the Viability of Buds by R. P. N. Napper. Quarterly Journal Vol. 2, No. 4.
8. Test Spraying Experiments on Young Rubber by F. Beeley. Quarterly Journal Vol. 2, No. 4.

A. R. SANDERSON,

Acting Head of Pathological Division.

ANNUAL REPORT 1930.

CHEMICAL DIVISION.

In this report the work of the Chemical Division is presented in the form adopted for the year 1929.

The activities of the Division fall naturally into three classes: "Internal", "External" and "Advisory". The first embraces the laboratory work which is mainly concerned with pure research on latex and rubber. The other two sections are closely related and it is not always possible to differentiate between them. They comprise the investigations which are carried out for the immediate needs of estates and agency houses; some of these can be applied to the general requirements of the industry and come within the category of applied research work. For the purposes of this report such investigations may be regarded as "external" research. There is, however, some work which is distinctly lacking in any pretensions to research. This is classified as "Advisory" work. It must be recognised as a legitimate function of the Division and has, therefore, to be catered for when arranging programmes of research. The steady increase in volume of correspondence and the number of samples submitted for examination make it obvious that the need for this "Advisory" work is growing rapidly, and will become more pronounced as rubber growers are forced to adopt increasingly competitive methods of production.

Internal Work.

The progress which has been made along those lines of pure research which have been possible is sufficiently promising to indicate the desirability of prosecuting these investigations without any hindrance.

SEPARATION AND CHARACTERISATION OF LATEX CONSTITUENTS.

During the year advances have been made on the lines initiated in 1923 at the Department of Agriculture, and the isolation and characterisation of the lipin or jecorin like body present in Hevea latex, which was postulated by Belgrave, has now been described. A preliminary examination has been carried out on some of the effects of this interesting constituent of latex on the vulcanisation properties of rubber.

In addition to the vulcanisation effects which have been referred to in the Quarterly Journal (1) there is now some evidence to show

(1), Quarterly Journal, Vol. 2 No. 3.

the effect of Hevea lipin on the plasticity characteristics of plantation rubber. Preliminary studies in this direction indicate the value of a knowledge of the non-caoutchouc constituents of latex as a clue to the properties of raw and vulcanised rubber.

The isolation of the so-called carbohydrate in latex has not yet led to any new information concerning the occurrence of this constituent although the separation of quantities of quebrachitol have enabled us to carry out some promising work on the effects on vulcanisation of this substance, which has led to a study of the influence in rubber-sulphur mixes of mono and di-saccharides. It is thought that the true sugars exert an influence which depends upon their molecular structure, and the presence of keto or aldo oxygen appears to be important to the velocity of the vulcanisation reaction.

Continuing from this at the close of the year increased attention was directed to some of the differences exhibited by latex derived from selected trees. It has now been found that distinct differences in rate of vulcanisation are associated with those phenomena which are associated with the presence of peroxidases.

The more insight we obtain into the effects of the constituents of latex on the properties of raw rubber the more evident it becomes that only as a result of separating and studying individual constituents of latex shall we obtain the knowledge necessary to ensure the maximum industrial utility of our plantation products.

External Work.

The investigations more closely related to the immediate demands of the industry which have been carried out during the year embrace the following:—

The efficiency of sheet manufacture.

The drying of crepe and sheet.

The preservation and concentration of latex.

The cause and elimination of defects in lower grades.

THE EFFICIENCY OF SHEET MANUFACTURE.

This was made the subject of an investigation as a natural sequence to the work on the preparation of wide sheet which was initiated in 1929. Early in 1930 a questionnaire was circulated among estates manufacturing sheet with the object of ascertaining the efficiency of present methods of preparation. From the replies received an attempt was made to initiate improvements consonant with

average estate practice. A record of some of the results achieved has been published in the *Quarterly Journal*. (2).

The work is still proceeding and although progress latterly has been small it is encouraging. The steady maintenance of outputs of sheet amounting to 1300 lbs. of dry rubber per hour without an increased number of operatives is an accomplished fact on more than one estate, and the developments now being carried out by one estate engineer indicate the value to the plantation industry of this work. The paramount importance of converting the maximum proportion of the estate crop into a product of standard quality necessitates the highest efficiency and most careful supervision in the factory, and for this purpose close collaboration between the chemist and engineer has now been proved to be just as essential in the plantation industry as it is elsewhere.

In this connection, the developments of the industry which are being brought about by present economic conditions appear to point to a need for increasingly specialised supervision in estate factories designed to cater for larger and more continuous outputs.

The recent results which have been achieved by the Chemical Division in the preparation of sheet from latex which has been preserved for 72 hours and transported 20 miles indicate the possibilities of utilising central factories with separate supervision for manufacturing the crop from widely extended areas. It has been found by using latex preserved with sodium sulphite that a satisfactory product can be made which possesses all the superficial qualities of standard sheet and which conforms to the usual market requirements. The manufacture necessitates closer control in the factory, however, and it remains to be seen whether this and the transport of the latex can be accomplished economically.

THE DRYING OF CREPE AND SHEET RUBBER.

This is a continuation of the work which was in progress during 1929 and an extension, adapted to local conditions, of the work on the hot air drying of rubber initiated by O'Brien in Ceylon and van Heurn in Java.

The results of a questionnaire on smoke house efficiency have been examined and recorded in the *Quarterly Journal*, (3) and, arising out of those results, investigations concerning the relative efficiency of three types of smokehouse have been made on selected estates. The observations made during the course of the investigations and the work at the experimental smoke house attached to the Chemical Division bring out two points:—

(2), *Quarterly Journal*, Vol. 2 No. 4.

(3), *Quarterly Journal*, Vol. 2 No. 2.

- (1) The importance of preparing sheet *suitable* for drying.
- (2) The importance of controlling and distributing the heat.

The relationship between (1) and the efficient preparation of sheet depends upon a knowledge of the factors which affect coagulation and the treatment of the coagulum. It is only by a proper appreciation of factors such as coagulation and machining and their effect on the characteristics of the wet rubber that efficient drying can be maintained.

The control and distribution of heat during the curing of rubber depend largely upon the type of furnace and the manner in which it is fired. The latter is very much a personal factor. It is evident that much time and money are being wasted under present conditions owing to the unsatisfactory design of furnaces and the manner of their operation.

The investigations which are now in hand are devoted mainly to controlling the preparation of the rubber before drying and devising better means for applying heat.

With reference to this work we desire to record our thanks to those estates managers who have afforded us facilities for work on their estates and particularly to Mr. C. H. Hooper, the Engineer of the F.M.S. Rubber Co., for his advice and collaboration in connection with the engineering problems involved.

It is obvious that work of this description is badly needed by the industry. The desire to reduce staffs and supervision to an absolute minimum, coupled with the necessity for ensuring the maximum output of first class quality demands renewed attention to all stages of curing.

Present methods of drying and smoking are very dependent on the personal element and in the event of misuse are liable to cause so much loss through the production of imperfect rubber that it appears highly desirable to explore all means for effecting improvements.

THE CAUSE AND ELIMINATION OF DEFECTS IN LOWER GRADES.

During the period under review some attention has been devoted to the defects of lower grade rubber. From time to time estates which machine their own lower grades for export have received complaints concerning the development of stickiness in the rubber arriving in Europe. An attempt has been made to determine the cause of this defect with a view to its elimination.

Related to this, work has been carried out on the effect of manganese salts added to latex and appearing in abnormal quanti-

ties in sheet and crepe. The results obtained have been recorded for publication in the Quarterly Journal. (4)

The stickiness which develops in lower grades on ageing involves considerations of the effects of methods of preparation as well as the presence of traces of non-caoutchouc constituents. In connection with the preparation of rubber the suppression of stickiness by the use of anti-oxidants is a matter of particular importance. The laboratory technique involved in work of this description necessitates the elaboration of special apparatus. Progress in this direction is promising.

THE PRESERVATION AND CONCENTRATION OF LATEX.

During the earlier part of the year when it seemed possible that suitable plant could be obtained, latex concentration trials on a semi factory scale were initiated.

Although work on the concentration of latex does not affect the immediate needs of the average estate, it is regarded as being distinctly important for future purposes. With this in view laboratory investigations were undertaken on methods of sampling and the routine testing of stability, viscosity, hydrogen ion concentration, and associated factors. The investigations relating to hydrogen ion concentration in latex of different strengths have been published in the Quarterly Journal. (5)

In the factory small scale concentrations were carried out in a jacketed open steam pan and it was found possible to prepare concentrations containing up to 55 per cent of dry rubber. The keeping properties of these concentrates were, however, not equal to the keeping properties of the mother latex preserved under the same conditions, and observations on the stability of the preparations made it evident that until concentrators of more suitable design could be used the work should be discontinued.

Attention was subsequently directed to methods of preservation. It is realised that the practice of preserving latex by the addition of large quantities of ammonia cannot persist in an industry in which profits depend on narrow margins. Investigations have, therefore, been directed to improvements in the utilisation of ammonia as a preservative and it has been shown that when proper control is exercised the proportions of preservative required can be very effectively reduced. Laboratory trials have also been made with other preservatives and small batches of latex preserved with soda and potash soap were despatched to London for distribution and industrial report.

(4), Quarterly Journal, Vol. 2 No. 4.

(5), Quarterly Journal, Vol. 2 No. 3.

In connection with this work and a query which arose concerning the export of concentrated latex, a report has been prepared on the relationship between total solids and dry rubber content of concentrated and field latex. This work was carried out at the request of the Commissioner of Trade and Customs, Johore and involved the examination of a series of samples of concentrated latex and an investigation on the magnitude of the errors which may occur when concentrated and ordinary latex is sampled.

Advisory Work.

The volume of advisory work has shown a steady increase during the year. As an indication of this increase the figures for enquiries received by the Division are tabulated with those for previous years.

	1927-1928	1929	1930
Total Enquiries received	895	798	919

In connection with advisory work correspondence was held with 238 estates plus 94 individuals and agency houses.

The above list takes no account of the 200 estates which replied to the questionnaire on output of sheeting batteries, nor of the 50 estates concerned in the questionnaire on smoke houses. These involved considerable additional correspondence.

The Advisory work may be classified as follows:—

Subjects.	Enquiries received.	Percentage of Total.
Anti-oxidants of Latex	4	0·4
Anti-coagulants of Latex	19	2·0
Machinery of Rubber Manufacture	49	5·3
Vulcanising Machinery and Apparatus	6	0·6
Vulcanisation of Rubber	35	3·8
Rubber Seed Oil	1	0·1
Rubber Oil	8	0·8
Crepe	46	5·0
Crepe—Lower Grades	22	2·4
Coagulants	15	1·6
Rubber Preparation	15	1·6
Latex	43	4·6
Latex Preservation	55	6·0
Latex Concentration	28	3·0
Latex—Instruments for determining D. R. C.	38	4·1
Coagulating Tanks and Pans	64	7·0
Sole Crepe	39	4·2
Smoked Sheet—Defects (Bubbles etc.)	280	30·5

Smoke Houses	...	60	6.5
Air-dried Sheet	...	36	4.0
Water	...	16	1.7
Accelerators of Vulcanisation	...	4	0.4
Miscellaneous	...	23	2.5
Rubber Roadways	...	13	1.4

VISITS.

In connection with enquiries from estates, 129 visits were paid to estates compared with 52 visits during 1929.

PUBLICATIONS.

The following articles have been published during the year :—

1. Brown Bast. Some Considerations as to its Nature, by E. Rhodes. Quarterly Journal, Vol. 2. No. 1.
2. Results of a Questionnaire on Smoke Curing of Rubber, by R. G. Fullerton. Quarterly Journal, Vol. 2. No. 2.
3. The Lipin of Hevea Latex, by E. Rhodes and R. O. Bishop. Quarterly Journal, Vol. 2. No. 3.
4. Observations on the Effect on Vulcanisation of the Lipin of Hevea Latex, by B. J. Eaton, E. Rhodes and R. O. Bishop. Quarterly Journal, Vol. 2. No. 3.
5. Observations on the Coagulation of Hevea Latex, by R. G. Fullerton. Quarterly Journal, Vol. 2. No. 3.
6. The Preparation of Sheet Rubber, by R. O. Bishop. Malayan Agricultural Journal. Vol. 19 No. 1.
7. Sheeting Machines by R. O. Bishop and E. Rhodes. Quarterly Journal, Vol. 2. No. 4.
8. Manganese in Raw Rubber by R. O. Bishop and K. C. Sekar. Quarterly Journal. Vol. 2. No. 4.
9. Information Cards (Nos. 1c to 16c) on the preparation of Raw Rubber, Defects in Raw Rubber and Remedies.

GENERAL.

During the year lectures were given by the Acting Head of the Division to branches of the Incorporated Society of Planters at Taiping, Rengam and Tampin.

A paper on "The Preparation of Sheet Rubber by Small Holders" was read at the Inter-Departmental Conference held under the joint auspices of the Department of Agriculture, the Co-operative Societies Department and this Institute. Arising out of this Conference the Head of the Chemical Division served on a Committee appointed to report on the marketing of peasant produce.

At the Malayan Agri-Horticultural Association Show and at several district Agricultural Shows exhibits were prepared and staged by this Division. A feature of these exhibits was the representation of methods of preparing sheet rubber by efficient and imperfect practice.

The work in connection with the Malayan Exhibition held in Kuala Lumpur during April involved considerable preparation and occupied the whole of the staff of the Division for six days.

In connection with these Exhibits and the dissemination of information in a concise form a series of Information Cards was prepared. Sixteen cards are now available and a further three are in course of preparation.

R. O. BISHOP,

Head of Chemical Division.

ANNUAL REPORT 1930.

BACTERIOLOGIST.

The investigations carried out during 1930 were chiefly concerned with (a) latex bacteriology and (b) soil bacteriology. Early in the year the work on latex was brought to a close owing to the more pressing claims of soil microbiology. Almost all the work has been published and brief reference only is made to the more outstanding features.

Bacteriology of Latex.

The results of this investigation have already been reported (Quarterly Journal, Vol. 2 No. 3) and little remains to be added.

The organisms isolated from Hevea latex are striking in that their nearest allies are species found in the animal body and not in the soil. The latex bacteria grew poorly, or not at all, on the media usually employed for soil organisms and growth was maintained in the laboratory on a latex agar.

Two of the species isolated are of interest in connection with the natural coagulation of latex. Of these, *Bacillus pandora* (Corbet) produced acid with latex serum while acid and gas resulted from inoculation of this medium with *Micrococcus epimetheus* (Corbet). It has been generally assumed that acid production in latex is the result of bacterial decomposition of the methyl l-inositol (quebrachitol) present. No justification was found for this assumption since *B. pandora* failed to produce acid in presence of the inositol while *M. epimetheus* gave acid but no gas only in presence of a magnesium salt. It seems probable that latex contains some carbohydrate which is responsible for acid and gas production when attacked by the appropriate microorganisms and in this connection it is of interest to note that Rhodes and Bishop (Quarterly Journal, Vol. 2 No. 3) have recently isolated a hexose from latex.

Bacteriology of Soil.

It will be convenient to discuss this work under several headings although all form parts of one investigation.

(a) BACTERIAL POPULATION OF THE SOIL.

In continuation of the work of 1929, at approximately weekly intervals determinations were made of the numbers of bacteria present in the soil on a selected site at the Institute Experiment Station

at Sungei Buloh. On the block used for this experiment rubber seedlings and a cover of *Centrosema pubescens* were planted towards the end of 1929 and the cover has grown well during the past year.

Some bacterial counts were made also of soil from the neighbouring primary jungle and from a neighbouring rubber estate. In all cases, the counts were uniformly low, the numbers rarely exceeding 1 million micro-organisms per gram of soil, while the average value was below 0.5 million. Judged by the plate-counting method, there was little variation in the micro-flora of the soils from different sources.

With one exception, fungi predominated over bacteria on all the plates and, in most cases, only a few bacterial colonies were present.

The sole exception was a soil sample taken from rather low-lying ground near a small stream on a rubber estate. This soil contained numerous earthworms, *Pontoscolex corethrurus* (Fr. Müll.) and gave a bacterial count of over one million and in this case the colonies were almost all bacteria and not fungi.

Samples from a coastal estate with soil of a peaty nature gave very low counts and the colonies consisted entirely of moulds and fungi.

From these results, the conclusion may be drawn that, unless unusual conditions obtain, the number of micro-organisms in the soil here tends to reach a constant value. It is doubtful however, how far such a deduction is justified for, although the usual plating method was adopted and Thornton's agar was employed as the nutrient medium, it seems clear that this method is of qualitative value only in the Tropics. Apart from the usual disadvantages inherent in the method, a further strain is placed on it by the low micro population of the soil and the predominance of fungi. In the near future, it is proposed to test the method on a hill station where more temperate conditions prevail but it is safe to say that, in the low-lands of Malaya, it is of little value for comparative work.

(b) DECOMPOSITION OF SOIL ORGANIC MATTER.

It is important that a reliable method should be available for assessing the biological activity of the soil and it is evident that the method of bacterial counts is unsatisfactory.

As a result of experimental work carried out during the past two years, it has been found that a much more accurate measure of biological activity, and hence of soil fertility, can be obtained by estimating the rate of carbon dioxide production from soils. The method employed will be described in detail in a forthcoming issue of the Institute's Journal.

The results obtained by this method to date show that the daily yield of carbon dioxide in milligrams, called the "fertility constant" is about 12 for jungle and good estate soils. Changes in the fertility constant which may result from desiccation, addition of fertilisers, etc. can be readily determined. A series of experiments was carried out in which fertilisers were added to the soil at the rate of 5 cwts. per acre and the effect upon carbon dioxide production measured. In this particular case it was found that lime and sulphate of potash each produced no change, sulphate of ammonia gave a slight increase while a mixture containing nitrate, potash and phosphate increased the fertility constant by nearly 40 per cent.

(c) FATS AND WAXES IN SOIL.

The presence of fats and waxes in soils may be a matter of some importance from the standpoint of soil bacteriology. It is known that some soils are richer in fatty materials than others, and that some species of micro-organisms are able to decompose and others to synthesise fats. The decomposition of fats in the soil is normally slow and in dry soils appears to be very slow indeed. In view of the fact that the soils of most rubber estates are exposed to the sun during the first few years of their existence, the question of the presence of fats and waxes in the soils may be an important one in relation to soil fertility.

A start has been made with an examination of the chloroform-soluble substances present in different types of soils. Soil from the Sungei Buloh Experiment Station from a clearing about 2 years old was found to contain 0.16 per cent. of chloroform-soluble material, of which half consisted of fatty acids. A peat soil contained a much higher proportion of chloroform-soluble material, about 60 per cent. of which comprised fatty acids. The latter soil is of particular interest in that a series of platings from it revealed no bacteria.

The fertility constant of the Sungei Buloh soil was determined before and after chloroform treatment by the method of measuring the rate of carbon dioxide production and it was found that removal of the fatty materials by chloroform raised the fertility constant from 11.3 to 14.3. These figures indicate quite an appreciable increase in microbiological activity when it is remembered that the soil contained only 0.16 per cent of chloroform-soluble substances.

(d) SYSTEMATIC BACTERIOLOGY.

As a rule little time is spent on systematic work by the soil bacteriologist unless an organism is isolated which possesses some striking characteristic. This appears to be rather a mistake for, while

it is true that systematic bacteriology rests on a rather insecure basis and makes heavy demands on the investigator's time it is desirable that we should be in possession of some detailed information regarding the more common soil organisms in a country such as Malaya. The numbers of bacteria in a soil are of little importance compared with their functions.

During the past year, two species of cocci were isolated from soil at Fraser's Hill and subjected to detailed examination. Both species proved to be hitherto unknown and both reduced nitrate to nitrite but not to ammonia.

PUBLICATIONS.

The following paper has been published in the Quarterly Journal during the year :—

"A Preliminary Study of the Bacteriology of Hevea Latex" Vol. 2, No. 3.

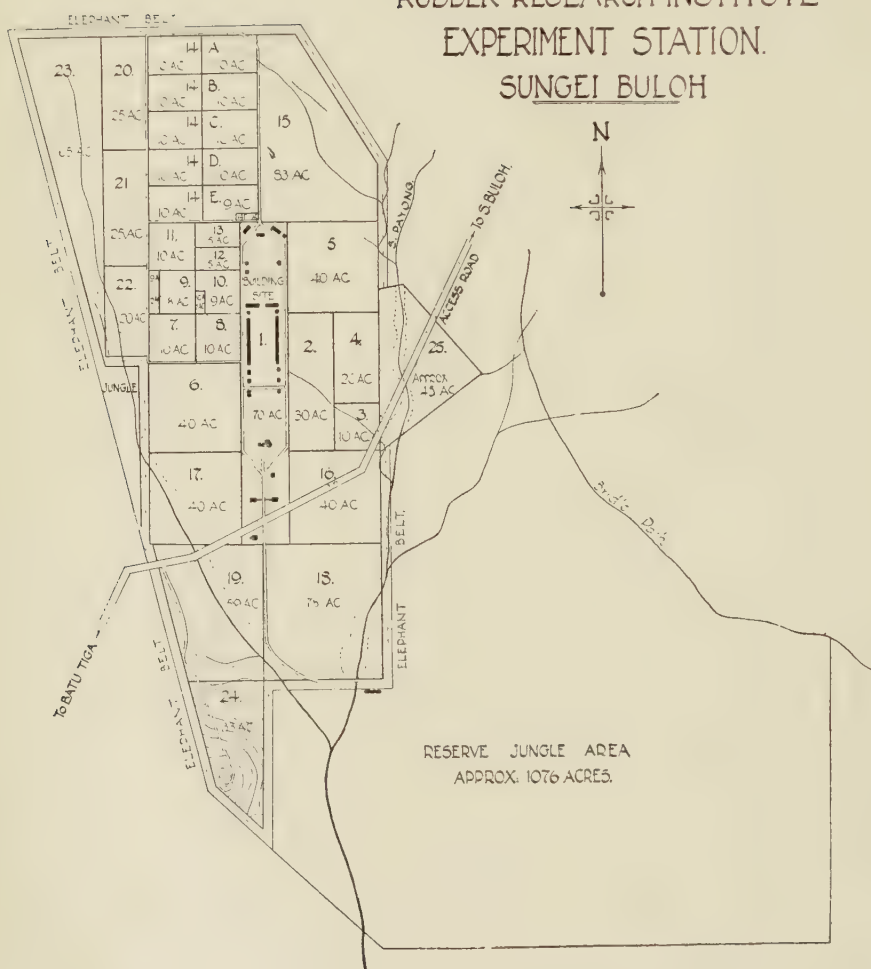
The following paper has been prepared for publication :—

"A Bacteriological Study of the Decomposition of Soil Organic Matter and its bearing on the Question of Manuring."

A. STEVEN CORBET,

Bacteriologist.

RUBBER RESEARCH INSTITUTE EXPERIMENT STATION. SUNGEI BULOH



ANNUAL REPORT 1930.

EXPERIMENT STATION.

The total area of the Experiment Station, which is situated in the Sungei Buloh Forest Reserve, 16 miles from Kuala Lumpur, is 2045 acres. The following details show the development of this area at the end of 1930.

ACREAGE STATEMENT.

Planted	...	733 acres.
Cleared (for planting)	...	53 "
Cleared (not planted)	...	27 "
		813 "
Elephant belt	...	86 "
Building site	...	70 "
Total area opened	...	969 "
Jungle Reserve	...	1076 "
Total area under application	...	2045 "

DISTRIBUTION OF LAND.

Botanical Division	...	356 acres.
Soils "	...	168 "
Pathological "	...	289 "
Building site	...	70 "
	...	883 "

CLEARING.

Area cleared in 1928	...	200 acres.
" " 1929	...	475 "
" " 1930	...	294 "
Total	...	969 "

During the period under review no timber for sale was cut by the contractors owing to the depressed state of the market. An area of 200 acres in the Reserve jungle has been marked out and a

contractor was allowed to remove good timber from this area on payment of an equivalent of 40 per cent. of the royalty normally paid to the Forestry Department. To date a sum of \$304/- has been realised, whilst there still remains a good stock of timber to be removed. Planks were supplied to the estate for the cost of labour only.

The Sungei Payong area which previously had been occupied by squatters was taken over in 1930. It was completely cleared of all stumps and surface timber and at the same time the existing elephant barricade was cleaned up.

HOLING & FILLING.

An area of 130 acres has been holed and filled during the year for normal planting as follows:—

<i>Block.</i>	<i>Area.</i>	<i>Spacing.</i>	<i>Size of holes.</i>
23	65 acres.	22 ft. × 22 ft.	3 ft. × 3 ft. × 3 ft.
25	45 „	20 ft. × 22 ft.	2 ft. × 2 ft. × 2½ ft.
22	20 „	22 ft. × 22 ft. 18 ft. × 18 ft.	} 2 ft. × 2 ft. × 2½ ft.

PLANTING.

Details of new planting are as follows:—

<i>Block.</i>	<i>Area.</i>	<i>Spacing.</i>	<i>Material.</i>
14	40 acres.	Various.	Budded stumps.
22	10 „	18 ft. × 18 ft.	Non Hevea rubber
	10 „	22 ft. × 22 ft.	plants, Puchong
			Estate seed.
23	65 „	22 ft. × 22 ft.	Kepong Estate
			Seedlings.
S. Payong			
25	2 „	20 ft. × 20 ft.	Crosses from
			Pilmoor Estate clones.

All planting material, whether germinated seed or seedlings, was planted out in baskets. It was necessary to obtain several thousand seedlings from Kepong Estate, owing to a failure in the germination of the seed from Puchong Estate. I am indebted to the General Manager, Kepong Estate for his help in this matter.

Block 14. The original planting in Block 14 consisted of a density experiment in strips from east to west under cleared and uncleared conditions with five planting distances namely 30 ft. × 30 ft., 20 ft. × 20 ft., 14 ft. × 14 ft., 12 ft. × 12 ft. and 10 ft. × 10

ft.; this area was thought to be too large and the control area of 40 acres in plots C & D were utilised for this experiment as shown in the plan below, under conditions which are considered to be more similar; budded stumps were used as planting material.

PLAN OF BLOCK 14.

Material. Budded stumps of AVROS 50.

B	C	F	D	A	E
A	D	C	B	E	F
C	F	E	A	B	D
D	E	A	C	F	B
F	B	D	E	C	A
E	A	B	F	D	C

- A. 30 ft. x 30 ft. square.
 B. 20 ft. x 20 ft. „
 C. 14 ft. x 14 ft. „
 D. 12 ft. x 12 ft. „
 E. 10 ft. x 10 ft. „
 F. 20 ft. equilateral triangle.

Dirty. Clean cleared.

Planting operations were greatly assisted by ideal weather. In Block 23, a clearing planted entirely with basket seedlings, there is an excellent uniform growth.

Block 23 (65 acres).—It was decided to interplant this area with coffee, pineapples and tapioca together with control blocks. 19 acres of coffee 10 ft. x 8 ft. quincunx, 11 acres of pineapples 6 ft. between the rows and 3 ft. apart in the rows, and 13 acres of tapioca in rows 4 ft. apart and 2 ft. between plants were laid down. There was insufficient material available at the Government Experimental Plantation, Serdang for the area required, and material was obtained from estates near Sepang. High grade varieties of Coffee-Robusta, Liberia and Uganda and good Golden Queen and Sarawak pineapples were planted; a useful revenue is expected to be derived from this area.

The detailed plan of this area will be published subsequently in the Experiment Station Guide.

Block 22.—This area of 20 acres is planted as follows:—Northern 10 acres—Puchong Estate Seed. Southern 10 acres—Non Hevea rubber yielding plants.

Sungei Payong Block (Block 25).—This area of 45 acres has been divided as follows:—38 acres of high land above stream on east and west, reserved for the Geneticist; 7 acres of level areas adjacent to either side of the stream to be used as a multiplication nursery by the Plant Physiologist.

In this latter area many difficulties were met in the shape of buried timber. Thorough cleaning was necessary to ensure future success, entailing a large amount of heavy work; the soil was dug over to a depth of 3 feet, and thoroughly limed before making the beds. This nursery will have the advantage of never being affected by drought. Boundary drains have been put in every 4 ft. whilst at every 10 yards there are outlet drains 2 feet deep.

Lime was broadcasted and dug in, at the rate of 2 tons per acre, in two applications. It was found necessary to employ a conductor to superintend this work, since the coolies sometimes neglected to dig to the full depth and also left roots in the soil.

It was thought advisable, where growth was poor in Blocks 2, 15 and 18, to supply with one or two basket plants per hole.

Block 2.—This area which was previously planted 30 ft. $\times$ 30 ft. has been interplanted quincunx. These supplies will be budded at the earliest possible date.

Block 22.—In the northern 10 acres, 3 acres were dug over to a depth of 3 ft. and all wood and small twigs were removed. Labour for this work was on contract and a kongsi had to be hired. This area has been planted 22 ft. $\times$ 22 ft. with basket plants. The treatment of this area was sanctioned by the Experiment Station Committee. The object of the experiment is to ascertain whether the very thorough digging over and removal of all wood derived from the jungle stumps in the soil will prove effective in the prevention of root diseases.

NURSERIES.

The 3 acre nursery in Block 12 has been treated with fungicides. In this area 25 beds each of 200 plants were cut back and treated with numerous wound dressings. When the cut back stumps had sprouted again, spraying tests with a sulphur duster and a hand sprayer for liquids were carried out. In the reserve area on the western side of the above plots 40 beds were laid out. The soil in twenty of these beds was treated with various chemicals, after which germinated seed were planted. The balance was used for control beds and also planted simultaneously with germinated seed.

BUDDING.

Budding operations have been carried out on the following Blocks :

Block.				Area.
3	...	...	...	10 acres.
17	...	...	...	10 "
19	...	...	...	36 "
24	...	...	...	33 "
14	...	...	...	40 "
8	...	...	...	4 "

Budding has also been done in the two multiplication nurseries in Block 4 and on the building site. The budders consist of 11 Chinese and 1 mandor and 6 Tamils. The percentage of successes obtained by both groups has been most gratifying and the only difference is that the Chinese bud a few more plants each day than the Tamils. During the year fifteen estates have been visited by our budders, for the purpose of instructing and assisting in budding operations.

On the building site a 1 acre multiplication nursery was laid out. Transplanted budded stumps were used, being planted 4 ft. $\times$ 2 ft. There are about 50 tested clones in this area.

Block 4 Nursery.—This area is being budded generally with tested clones; already from several plots budwood is available for sale. About 60—70 clones have been budded in plots on this area.

The Plant Physiologist inaugurated a replicate experiment of Block 5 on Edinburgh Estate. This work was carried out by our budders and a final success of 88 per cent. was obtained. The budwood used was Tjirandji 1, AVROS 49, B.D. 5, P.B. 23 and 186, Pilmoor A. 44 and B. 84. The Institute has now the privilege of obtaining all data from this area and of showing it to visitors.

The budders were paid at the following rates : Chinese Mandor \$1.50, Chinese budders \$1.00 and Tamil budders 70 cents per day.

This is an inclusive rate for work from 6 a.m. to 6 p.m. On final opening a bonus of 2 cents per success is charged to the estate in addition to the above daily wages. Transport by rail and otherwise to and from estates is also charged, and this adds to the cost where estates are at a considerable distance from the Experiment Station. The cost for successes on any estate near Kuala Lumpur, works out, on a 70 per cent. success basis, at 6 cents per plant, which includes labour, materials and transport, exclusive of budwood.

Next year budders will only be available when not being employed on the Station, since the Board has decided to reduce the number of budders. It may be thought that the charges for budding labour are high, but the Malays on completion of training were "crimped" and we were compelled to increase the wages to ensure that our demonstration gang was not lost every few months.

MANURIAL TREATMENTS.

Block 6.—This plot consists of 5 randomised manure plots and a control replicated 6 times; these plots have received quarterly applications of fertilisers. Height and girth measurements have been taken again and the results will be published later by the Soils Division.

Block 17.—This block has received treatments with Cresite, Nitrophoska and Magnesium Sulphate. The Nitrophoska was applied on a commercial basis, over the cover crop strips. A nursery of 16 seed beds has been planted. The soil was treated with Nitrophoska previous to planting with germinated seed. A mulching experiment is still to be carried out when the seedlings are sufficiently large.

Block 23.—At the northern corner, an area of 20 acres was laid down as a liming experiment, divided into 1 acre strips treated with amounts varying from 1 to 5 tons of lime per acre and 1 acre controls. This area has since been duplicated. This experiment is to determine the effects of liming and also the incidence of *Fomes lignosus* on land so treated.

DRAINAGE.

The existing drainage scheme, including all anti-malarial drains, has been well maintained.

In Block 15, a hill foot drain $42\frac{1}{2}$ chains long was constructed and the plants in this area have benefited considerably from the drier conditions.

In Blocks 14, 20 and 23, 473 chains of 3 ft. drains were constructed.

Blocks 20, 21 & 23.—The area comprising Blocks 20, 21 and 23 was found at times to be very wet; a 10 ft. $\times$ 7 ft. drain, with 2 ft. bunds on either side was cut through the centre of the area. This drain has now completely dried up the area and the resultant improvement in growth is very noticeable.

The Sungei Payong area has been cleaned and deepened for a distance of 20 chains, where the stream leaves Block 18 and flows into the Reserve area. Considerable silting up of the stream occurs and upkeep will be heavy for some time.

TERRACING, SILT-PITTING AND BUNDING.

The hill in Block 24 was treated again since, owing to the loose nature of the soil, the old terraces were practically non-existent. New terraces 7 ft. wide with protecting bunds were cut. An average of 30 chains of terraces per acre were excavated. On top of the hill, each plant was ring banded. In Block 19, where there was extra wide spacing of the pits and bunds an intermediate pit and bund were constructed. Bunds which are all on the top side of the pits are contoured and are 2 ft. high. In Blocks 2, 4, 5 and 18, one-chain square bunding was carried out. The bunds were made 2 ft. high and for protection purposes cover crop seed was immediately planted on them. In Blocks 22 and 23, silt pits and bunds were constructed over an area of $38\frac{1}{2}$ acres. A total of 389 chains of similar work was done in Block 15.

LEVELLING.

No extensive levelling was done, but for anti-malarial purposes, large stump holes, near the Sungei Payong were filled up. Rough levelling has been done round the Guest House site.

COVER CROPS.

The cover crop nurseries in Blocks 13 and 17 were supplied and a number of new covers were brought from the Institute and planted in Blocks 20 and 21. *Crotalaria*s and *Centrosema pubescens* are noticeably the most quick growing and healthy varieties of covers on this type of soil. *Centrosema pubescens* was planted over the 45 acres in the Sungei Payong and in Block 14 on the southern 50 acres. In Block 22, 20 acres of *Centrosema* and *Vigna* were mixed. The high growing covers are cut back at regular intervals.

In Block 17, the 2 acre cover crop nursery has had to be supplied several times, the area being badly affected by the long drought during July and August.

PESTS AND DISEASES.

Rats, grass-hoppers and crickets are still troublesome, but these pests are being gradually reduced. Damage from elephants occurred

once, when these marauders found a path made by squatters on one of the boundaries, and damaged a few plants in Blocks 5 and 6. However the Game Warden took their extermination in hand and since that time (April—May) no elephants have been seen. The elephant belt is proving eminently useful in keeping out these animals.

Root disease control and experiments on disease of covers have been undertaken by the Pathological Division. Two motor dusters and a hand sprayer, for sulphur treatment of trees attacked by leaf diseases, especially *Oidium Heveae*, have been purchased and are now on the Station.

Fomes lignosus has been prevalent on a number of Blocks but this has been taken in hand, and a uniform method of treatment by all Divisions has been carried out.

HEIGHT AND GIRTH MEASUREMENTS.

Height and girth measurements of all the trees in the following Blocks have been taken and details sent to the Institute :—Blocks 2, 3, 5, 6, 7, 8, 9, 10, 11, 13, 17, 19 and 24.

In Block 5 a regular monthly height record of the budded stumps has been taken.

RESERVE JUNGLE.

Very little has been done in regard to the cutting and sale of timber since contractors are not keen on taking up the work, owing to the depressed state of the timber market. No further felling of the Reserve Jungle for planting purposes has been carried out.

ROADS AND BRIDGES.

305 chains of roads were levelled and metalled during the year, over the main area. Four large culverts had to be laid. Two rounds of upkeep, spreading metal and rolling were completed.

It was decided to build a road up the hill in Block 24 at the south western corner of the station. The road which was 70 chains in length was completed during the year. Cement channels have been laid along the upper side. Stop boxes with outlet pipes across the road were put in every three chains.

BUILDINGS.

During the year the following buildings have been erected and completed.

- (1) Guest House and Garage.
- (2) Chinese Budding Coolies' Line.

- (3) 3 Conductors' Bungalows.
- (4) Artificial fertiliser and anti-malarial stores.
- (5) 2 sets of bachelor coolie lines.
- (6) House for Jewell Filter on the water pipe line.

The septic tank installation at the Manager's bungalow was completed and is satisfactory. The Guest House, which has now been open for some time, is of great value to the Institute staff and to visitors.

WATER SUPPLY.

Owing to the temporary water scheme of wells proving useless for nearly three months in the year, search was made for a good supply of water in the neighbouring jungle area. Many streams were inspected, all except one however were found to become dry after a prolonged drought. Measurements of the flow of water in this stream were taken; it was found that a minimum supply of 30,000 gallons a day was available. Unfortunately the distance from the building site is rather great and necessitated a pipe line $3\frac{1}{2}$ miles in length. A scheme has been completed and water is now laid on to all lines and bungalows. At the time of writing it is working well, and has the advantage of not requiring any upkeep. The outlay involved was \$17,000/- but it should be noted that \$2,000/- of this amount was spent on a Jewell filter installed by order of the Health Officer, Selangor.

HEALTH.

Health has been very good for the greater part of the year. Permission was obtained from the Forestry Department to take over the 40 acres occupied by squatters on either side of the Sungei Payong. When this area was thoroughly cleaned up, the improvement in health on the station was most noticeable. During the year there have been only 42 hospital cases, 13 of which were due to relapsed malaria. The spleen rate has decreased as shown below :—

		<i>Men.</i>	<i>Women.</i>	<i>Children.</i>
		per cent.	per cent.	per cent.
1929	...	14.7	25.6	23.7
1930	...	1.5	6.6	14.7

Anti-malarial work. Only upkeep work has been done. Costs inclusive of labour and oil have been reduced to \$106/- per month. The Health Officer, Selangor East, has assisted greatly with advice on anti-malarial work and together with the Visiting Medical Officer

(Dr. McGregor) and the resident medical assistant, is to be congratulated on the improved conditions. The health of the European staff has also been good and there have been no admissions to hospital for fever.

GENERAL.

The staff on the experiment station at the 31st December was as follows:—

Manager.
 Assistant.
 Office Clerk.
 Dresser.
 Conductor, (Field).
 3 Institute Conductors.

Mr. C. V. Cavendish, was engaged as Assistant on the 1st February and left on the 1st May. The Board decided to appoint Mr. H. G. W. Mathews to be assistant on his return from long leave in January, 1931. Owing to pressure of work, it was found necessary to engage a temporary assistant from August and Mr. A. E. Ford was appointed. Mr. Ford has worked well and assisted me very greatly during his period of service. The improved health conditions have rendered the working of the station much easier than during 1929. It is a pleasure to record my thanks to the Asiatic staff of the station, who have assisted me greatly. Mr. D. S. Gardner has continued as Visiting Agent and I take this opportunity of thanking him for his advice and assistance.

Many planters and others, including members of various foreign Research Stations have visited the station.

A History File and Costs Card of all the Blocks, which have been kept from the inception of the Station are open to inspection at the Experiment Station Office. Constructive criticism of costs and of the general planting work by planters is welcomed by the staff.

Rainfall. The total for the year was 96.26 inches, distributed as follows:—

Jan.	Feb.	Mar.	Apr.	May.	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
7.23	7.76	7.94	13.12	7.80	8.55	1.08	3.67	4.00	15.30	8.69	11.12.

(Sgd.) H. W. FOSTON,

Manager.

ANNUAL REPORT 1930.

FIELD DIVISION.

The Chief Field Officer assumed duty in February and throughout the year paid visits to estates in company with other officers of the Institute as occasion arose. Special visits were paid to Kedah, Johore, Pahang and Kelantan in order to become familiar with planting conditions in each State. Mr. F. Beeley was sent to Kedah and Kelantan to make special reports on small holdings in those States and also visited most of the large estates in Kelantan and submitted a report.

AGRICULTURAL SHOWS.

In conjunction with the Department of Agriculture special exhibits were staged at all the District Agricultural Shows and at the Malayan Exhibition, Kuala Lumpur held under the auspices of the Malayan Agri-Horticultural Association. At all of these one or more members of the Field Division was in attendance for consultation with planters on particular problems on which advice or information was required.

The following is a list of the shows held during the year with a resumé of the principal activities and exhibits of the Institute.

Seven Agri-Horticultural Shows have been held during the year at the centres shown below.

1. The Seventh Malayan Exhibition held in Kuala Lumpur, 19th-21st April.
2. The Kedah Agricultural Show held at Alor Star on 10th and 11th July.
3. The Negri Sembilan Agri-Horticultural Show at Seremban 25th and 26th July.
4. The Malacca Agri-Horticultural Show at Malacca on 26th July.
5. The North Perak Agri-Horticultural Show at Taiping on 23rd and 24th August.
6. The Pahang East Agri-Horticultural Show at Kuantan on 26th August.
7. The Temerloh Agri-Horticultural Show at Temerloh on 27th September.

At each of these Shows exhibits prepared by the Research Staff were displayed dealing with such factors in the treatment of diseases of the rubber tree, the improvement of yield of latex

by budding and in the production and preparation of raw rubber as were deemed to be of the greatest educational value to producers.

Kuala Lumpur. At the Malayan Agri-Horticultural Exhibition in Kuala Lumpur at least one officer of each Division was in attendance during the whole period. At the District Shows the Field Staff assisted by subordinate members of the staff attended to answer inquiries and to give such demonstrations as the nature of the exhibits demanded.

A special effort was made to make the exhibits at Kuala Lumpur as comprehensive as possible; these included (1) Pests and diseases with methods of treatment, (2) Budding Operations, (3) The Preparation of first grade rubber, common faults in rubber and their causes.

The Pathological exhibits included specimens and photographs of all the important diseases of the rubber tree. These were conveniently divided into diseases of the root, the stem and the leaves. One interesting exhibit was an enlarged micro-photograph of the fruiting bodies of *Oidium Heveae*, this being the first time that such a subject has been shown in this country. In connection with this disease a motor duster was also exhibited showing the method of treating the trees with sulphur.

All exhibits were labelled both in English and Malay (Jawi) character and in addition leaflets were distributed explaining the methods of identification and treatment of each disease. Chemicals and proprietary preparations used for the treatment of diseases were also exhibited.

The Botanical Division concentrated on budding operations. Several demonstrations were given each day on the most satisfactory method of procedure in this operation. These demonstrations proved highly popular especially owing to the fact that many were given entirely in Malay. Preserved material and photographs showing the development of the bud were also on view in order to illustrate the operations and subsequent growth. Many interested persons took advantage of this opportunity to make themselves conversant with modern methods.

The Chemical Division exhibits covered all the phases of preparation of raw rubber from latex as received at the estate factory to the finished raw product in the form of sheet, crepe, sole crepe, preserved and concentrated latex.

The methods adopted to produce a first class product were contrasted with methods producing an unsatisfactory product.

The common sources of faults were emphasized and specimens of sheet and crepe showing such faults were displayed to advantage by a special system of lighting. Particular attention

was given to dilution, settling and straining as a means of freeing the latex from bark and sand particles. This portion of the exhibit evoked much interest and discussion with planters.

Specimen bottles and samples of the various chemicals used in the preparation and manufacture of rubber were on view together with leaflets describing the particular function of each. Leaflets dealing with methods of preparation and defects in raw rubber were also used to explain the exhibits.

The Information Cards now being issued by the Institute were also exhibited and planters generally paid tribute to the value of these.

All publications of the Institute were on sale. Free distribution of the leaflets relating to diseases of the tree, methods of preparation and defects in raw rubber were also made.

Special demonstrations were also arranged on two mornings under the auspices of the Co-operative Societies Department for penghulus, selected Malays and Malay Members of various Co-operative Societies.

District Shows. At the Seremban and Taiping Shows similar exhibits were staged but on a smaller scale. At the Taiping Show an exhibit from the Soils Division was also included. This consisted of representative soil profiles showing jungle soil with its distinct humus layer, good estate soil with the humus layer still present and bad, improperly managed estate soil with the humus layer absent. Bottled samples of the common artificial fertilisers used on rubber estates were also exhibited.

At the other District Shows small exhibits were staged embodying chiefly the scheduled diseases and their method of identification and treatment, the proper dilution and straining of latex to improve the quality and value of the sheet rubber produced. At these smaller Shows a particular attempt was made to interest the small holder.

The experience gained during the year at these Shows will enable improvements to be effected for future Shows, including if possible a display of attractive coloured posters.

RURAL PROPAGANDA.

In pursuance of the policy of a scheme for rural propaganda organised jointly by the Department of Agriculture, S.S. & F.M.S., the Co-operative Societies Department, F.M.S. & S.S. and this Institute, the Division is undertaking the work of preparation of exhibits and films in relation to rubber cultivation. A small film apparatus was procured and the preparation of special films for educational purposes was commenced. At the same time the

preparation of a series of lantern slides, in order to focus attention on details, was arranged. After a short trial the opinion now formed is that, while films will be very useful for this type of work, lantern slides are also essential for lecturing and demonstration purposes when dealing with subjects such as rubber diseases and the preparation of raw rubber.

A scenario relating to Mouldy Rot is being prepared and the filming of this will be undertaken later.

ADVISORY VISITS.

Apart from the advisory visits by the Field Officer stationed in Johore a number were carried out by the Chief Field Officer. These were mostly of a general nature where a report on actual local conditions was required. A few were also made at the request of the Research Divisions in relation to special problems.

EXPERIMENTS.

In the general scheme of the work of the Institute the Field Division will also give assistance and supervise Field Experiments which are carried out on estates.

Very little of the practical side of this work could be definitely taken over this year, owing to the shortage of staff in the Research Divisions and the attachment of two Field Officers to the Botanical and Pathological Divisions respectively.

EXPERIMENT STATION VISITS.

In the Quarterly Journal (Vol. 2, No. 2) it was announced that planters desirous of visiting the Experiment Station should inform the Director or the Chief Field Officer. During the period under review only a few planters have taken advantage of this, although many planters have visited the Station with members of the staff of the Botanical Division for special instructions on budding operations.

ADVISORY CORRESPONDENCE.

128 advisory letters relating to various problems in connection with rubber cultivation were dealt with during the year. Details of these are given in the following table:

Chief Field Officer.

Subjects.	Letters received.	Letters despatched.
Cover Plants ...	15	17
Fertilisers ...	1	3
Replanting ...	1	2
Manuring ...	9	12
Drainage ...	4	8
Bark Treatment Experiments ...	4	5
Soil Conservation ...	1	1
Wintering and Fruiting ...	8	8
Fungicides ...	1	2
Injury by External Agents ...	9	10
Visits ...	4	6
Budding—Estate enquiries ...	4	4
Packing ...	1	1
Tapping ...	2	2
Miscellaneous ...	32	47
	96	128

JOHORE.

A report concerning activities in the State of Johore by Mr. N. C. Jenkins, the Field Officer stationed in that State during the year is appended.

GENERAL.

Details for the formation of a Field Division which would enable several officers to be stationed in various States were prepared but owing to the present financial circumstances it was not found possible to give effect to these proposals. When the present approved staff is again complete, however, a Field Officer will be allocated for work in Kedah and Province Wellesley. This officer will also pay annual visits to the States of Kelantan and Trengganu. The northern and southern areas of the peninsula at the furthest distances from Headquarters will therefore be provided with Field Officers for general advisory work while similar work in the other States will be carried out by the Field Officers stationed at Headquarters.

This will save considerable time and expense in travelling and also relieve the Research Divisions of a lot of work in these areas at the same time keeping them in touch with the problems which arise.

G. DAVIDSON,
Chief Field Officer.

REPORT

BY

FIELD OFFICER, JOHORE.

PERSONNEL.

During the whole year a Field Officer was stationed in the State, and for his assistance a probationary clerk was employed from September onwards. For the period January to May a trained Junior Assistant, lent by the Principal Agricultural Officer, Johore, was in charge of three men employed by the Institute on work in connection with records and measurements on a number of small holdings and on his transfer one employee was retained on yield and bark consumption records.

Advisory Work.

In conformity with the policy that a considerable part of the advisory work of the Institute should be taken over by the Field Division, 185 visits to all districts of the State were made during the year, while 504 letters were despatched. Advice based on information and data supplied by the Research Divisions of the Institute, and from other sources, was given; this work, spread over the seven districts of a State approximating in area to Wales, with some five hundred and fifty large estates and seventy thousand small and medium sized holdings, fully occupied the energies of an officer working single handed throughout the greater part of the year.

LARGE ESTATES.

126 visits were made to 73 separate estates and 172 letters were despatched to estates and to individual planters.

133 letters were despatched to Government officers, business houses and others.

Due regard was paid to Asiatic as well as to European interests.

MEDIUM AND SMALL HOLDINGS.

59 visits were made to 36 areas of these classes of holdings. Close touch throughout the period was maintained with the Department of Agriculture, the existing organisation in touch with the small holder. Through this Department advisory matter is distributed, and

service extensions are proposed. When necessary, administrative and other Government officers have been consulted. The setting up of an organisation specially adapted for work among the small rubber holdings would entail the provision of a very carefully trained and supervised Asiatic staff.

During a tour of Java while on local leave, the Field Officer was able to study the activities of the Department of Agriculture, Netherlands East Indies, throughout that island; advisory work among native cultivators is conducted on an impressive scale, under the charge of highly trained natives, with Dutch agricultural advisers. Proefstations at Buitenzorg, Malang and elsewhere were also visited, and a good knowledge of the range of scientific agricultural advisory work and organisation in this 'progressive country' was gained.

Liaison with the Institute's work at Kuala Lumpur was maintained by frequent visits to the Research Laboratories and Experiment Station. In corresponding with various officers of the Institute 199 letters were despatched.

AGRICULTURAL SHOWS.

No shows were held in the State during 1930, and it now appears unlikely that those proposed for Muar and Kukub in 1931, at which the Institute was to have exhibited, will eventuate. Some estates were exhibitors in the Rubber Section of the Malayan Agri-Horticultural Exhibition held at Kuala Lumpur, which was attended by a number of planters, and also by a group of Malay Penghulus from Johore, who showed considerable interest in the demonstrations staged by the staff of the Institute, particularly those of budding, smoked sheet manufacture and defects, and of tree diseases. The Field Officer was on duty at these demonstrations, and throughout the period of the exhibition.

The Second Inter Departmental Agricultural Conference at Kuala Lumpur was also attended, and a number of estates in the Federated Malay States, on which particular problems had been dealt with by noteworthy methods, were visited.

LECTURES.

Lectures were given at a number of the principal planting centres by Research Officers of the Institute. These are shown in the Reports of the Research Divisions.

VISITS BY OTHER OFFICERS.

The Director and members of the Botanical, Chemical, Soils and Field Divisions paid visits to the State during the year.

Meteorological.

In view of the effect of rainfall in relation to certain diseases and other factors concerning the cultivation of rubber the following observations are of interest.

The Inland areas have experienced from three to five years of less than average rainfall and 1930 has in general proved the driest year of several, while low rainfall periods have been far more marked than usual. Coastal districts have experienced better conditions in this respect.

Closely connected with drought periods, and controlled by subsequent rain, an attack of *Oidium Heveae* was recorded and will be discussed later; conditions aggravated by dry weather also gave opportunity for attacks of leaf diseases of minor importance, such as *Helminthosporium Heveae* and of leaf-mites, while clearings in the Inland districts suffered through drying out of the soil but, except on areas of poor light soils, older trees were not appreciably damaged.

Leaf fires, especially in small holding areas at Segamat and between Muar and Tangkak, did considerable damage in dry periods.

Such diseases as Mouldy Rot and Black Stripe, which are favoured by damp conditions, were more easily controlled in the Inland districts, and did little damage in 1930 as compared with years of greater rainfall.

Soil Treatment and Improvement.

In spite of the low price of rubber, in general both European and Asiatic owners of the larger estates are adopting soil conservation and drainage methods, while the majority of new rubber clearings are now provided with terraces or similar protective systems, where other crops are not also grown. Leguminous cover crops, grass and other natural covers have been planted and encouraged on most properties.

Rubber on old cultivated areas, particularly in the South of the Johore Bahru district and on the Johore River, showing the "die-back" condition attributed to poor soil, has been considerably improved by the adoption of systematic improvement policies. Similar "dieback" appearance is also found in the older cultivated areas of Java, Sumatra and the Riouw islands, where the soil has not had subsequent attention.

Artificial fertilisers have been tried on a number of estates and, although some interesting results have been obtained, for experiments to be of value or wide application greater liaison will be necessary. At the present low price of the commodity in few cases does the manuring of mature rubber result in direct profit, though increased effective life of the trees, resistance to and recovery from disease should also be considered.

Soluble fertilisers (nitrogenous and phosphatic, or complete) have been very generally applied to improve young plants for early budding.

Bacteriological and soil analysis investigations now in progress at the Institute are of great interest, especially to South Johore estates, on many of which, in spite of recent improvements, there seems at present little hope of high yields.

USE OF IMPROVED PLANTING MATERIAL.

The great majority of the larger rubber estates which have recently opened new areas have utilised improved material. A table, compiled from information supplied by the Principal Agricultural Officer, by whom permits are granted for the importation of plant material from outside Malaya, is given below. From this material many estates have planted their own multiplication nurseries.

	1928	1929	1930
Budwood	... 35,000 metres	110,000 metres	47,300 metres
Seeds	... 700,000	687,000	7,000
Stumps	... 12,000	700*	18,000

* Some seedlings.

These figures are for imported material, all from the Netherlands East Indies, and do not include imports from other States in Malaya, budwood from which has also been used.

Block or mono-clone planting, chiefly with well proved clones, is increasing in favour.

On one estate experimental budding on stocks of *Hevea* species other than *H. brasiliensis* has been carried out. Another estate has had an area of buddings in tapping since September 1928. A number of estates send records from high yielding trees to the Institute.

Isolated seed gardens established on one property from 1928 onwards have made good growth; clone trial areas are now being established.

CATCH CROPS.

Pineapples, tapioca, tuba and to a small extent gambier, banana and coffee are subsequently planted with rubber by Chinese. The planting of fruit trees as an intercrop is also common amongst Chinese and other Asiatics while the interplanting of coconuts and arecanuts is also common. Experimental plots laid out with rubber and other crops at the Institute station should give interesting data in this connection.

COVER CROPS.

Cover crops, other than the common mixture of *Centrosema pubescens* and *Calopogonium mucunoides*, have had increased attention on estates. *Pueraria javanica* has proved a quick-growing plant, and somewhat tolerant of shade, while *Vigna* (*Dolichos Hosei*) is in some areas well established. On the poorer and previously cultivated soils cover plants have been difficult to establish: even *Mimosa invisa*, which is often tolerant of such conditions, has not always made good growth. Difficulty and expense of control prevent greater use of this plant which is most effective for soil improvement.

The rapid spread of root disease on areas with a complete carpet of cover plants has necessitated close control, and in some cases removal of the latter on a few estates.

TAPPING.

Under stress of low prices, a number of estates, especially where thinning had been neglected, have adopted a system of tapping high-yielding trees only, selected on yield tests. Good results have been attained, although there is some evidence to show that in the past when selective tapping has been tried, yield have fallen away after a period of months.

Diseases and Pests.

LEAF DISEASES.

As mentioned in a previous section (Meteorology) *Oidium Heveae* (mildew disease of rubber) broke out early in the year: it showed itself in abnormal secondary wintering on mature rubber trees on a number of estates in the mukims of Serom and Tangkak, and was also said to be present on neighbouring small holdings.

This disease was first reported in Malaya in 1925, and again in 1929; at Tangkak, rainfall was very low indeed for the first three months of the year (total 5.6 inches), followed by four times that amount in the following three months. The year 1930 was therefore one of an exceptionally low rainfall period in the affected district, comparable to conditions in those parts of Java where the disease has caused serious damage. Climatic conditions in Johore are in general unsuited to prolonged activity of the fungus, and extensive losses due to mildew attack are therefore not to be expected, though the disease appears to be able to persist for a long period without causing obvious damage to the leaves, and further dry periods will no doubt cause a reappearance.

Estates and areas which had been affected were re-visited later in the year by the Principal Agricultural Officer and by the writer;

the conclusion was formed that little real damage had occurred. Seed fall, as expected, was low in the district, however, and repeated defoliations would weaken the trees and possibly reduce yields. It is doubtful whether this attack was sufficiently serious to justify the use of power-driven sulphur dusters, although treatment should be borne in mind in the event of a further attack.

The disease was also reported from Gemas, which experienced even more severe climatic conditions.

Helminthosporium Heveæ, (Bird's eye spot disease of the leaves) and other leaf diseases were noticed on every clearing visited. Improvement later in the year occurred in those districts which had experienced severe dry weather. Mites, associated with the dry weather, also did much damage to leaves. Dieback (not due to *Diplodia*) followed attacks of minor leaf diseases, usually where there were also poor soil and climatic conditions. It was especially noticeable where two dry periods, with intervening rain, occurred, and on new clearings only. Mature rubber in the Johore River and South Johore areas also showed characteristic poor foliage and dead tips on branches due to soil and possibly climatic conditions

BARK DISEASES

Pink Disease (*Corticium salmonicolor*) is not serious, and has been confined in the past to the Segamat, Kota Tinggi and Central Johore districts. It has been correctly treated on estates, and, on the advice of the Agricultural Department officers, where found in small holdings.

Brown Bast has been treated on some estates by isolation or scraping, which have supplanted bark stripping, till recently widely practised in Johore.

Mouldy Rot (*Sphaeronema fimbriatum*), which is prevalent in every district of the State except Endau, has been checked in some districts by the dry weather. In spite of poverty, small holders have made efforts to treat the disease, and estates have treated with increasing success along the lines advocated by the Institute.

A more tolerant attitude is being shown towards small holders, and in some cases the disease has been treated by these people with disinfectants provided by estates; such co-operation, and the increasing educational activities of the Department of Agriculture, should have more effect than reliance on the Pests and Diseases Enactment, which could only be successfully enforced on every holding at enormous expense.

No cases of Black Stripe (*Phytophthora spp.*) were reported.

ROOT DISEASES.

Fomes lignosus in new clearings and old mature areas has caused much loss, especially on the lighter and rich soils, while *Fomes pseudoferreus* is principally found in the heavier soils in older rubber. Isolation work has been neglected on many estates during lean years.

Experiments on soil treatment with a view to re-planting or the protection of threatened areas, are watched with keenness.

Little root disease was found in small holdings, due probably to clearing up of timber for firewood, building purposes, and for the planting of catch crops.

COVER CROP DISEASES.

Sclerotium Rolfsii has caused the death in patches of *Centrosema* and *Vigna*, but new growth takes place, even where no treatment is applied.

MISCELLANEOUS PESTS.

In spite of the dry year, some damage to low-lying areas has been caused by floods. Damage from deer in most districts, from elephant and pig, grasshoppers, snails and slugs has been recorded, also from *Loranthus* (mistletoe) in small holding areas, and from a number of diseases, not sufficiently serious for further mention.

MANUFACTURE OF RAW RUBBER.

The majority of estates produced sheet rubber throughout the year; a notable tendency to reduce manufacturing costs of lower grades resulting in greatly reduced use of heavy machinery. A number of large estates manufactured crepe rubber and several manufactured sole crepe. One "Revertex" plant, for the production of concentrated latex, was in operation. The production of naturally coagulated slab rubber on one large South Johore property has now been abandoned. Preserved latex has, from time to time, been exported from several estates during the year, but local spray plants are not now in operation.

Many estates are giving closer attention to the preparation of a good quality product, and improved plant and appliances have been installed; this will no doubt result in a higher grade of produce. Some estates have their preparation processes closely costed.

Considerable interest has been shown in research on air-dried sheet, with a view to estate production.

Interest displayed in the improvement of sheet by the avoidance of various faults has been materially aided on estates by the distribution of "Information Cards" prepared by the Institute giving descriptions of faults and the remedies to be adopted.

Small holders produced throughout the year smoked or sun-dried sheet, subsequently smoked locally. Work in progress on the improvement of native manufacture which is progressing under the aegis of the Co-operative Societies Department in the Federated Malay States will be watched with interest, and progressive methods examined with a view to application in Johore, if feasible, under existing local conditions.

(Sgd.) N. C. JENKINS,
Field Officer.

THE RUBBER RESEARCH INSTITUTE OF MALAYA Inc.

Dr. INCOME AND EXPENDITURE ACCOUNT FOR YEAR ENDED 31st DECEMBER, 1930.

Cr.

EXPENDITURE.

To Experiment Station : Recurrent Expenditure	\$	c.	\$	c.	\$	c.
" Board and Committee Meetings :					64,296	51
Fees to Members			3,425	00		
Expenses of Members			983	87	4,408	87
" Salaries and Allowances :						
1. Senior Staff :			32,791	77		
(a) General and Office			106,061	60		
(b) Research			31,225	79	170,079	16
(c) Field						
2. Junior Staff :						
(a) Office Clerks			14,197	79		
(b) Graduate Assistants			12,318	11		
(c) Laboratory Assistants			16,827	43		
(d) Field Conductors			7,362	06		
(e) Laboratory Attendants			2,456	14		
(f) Library			4,781	29	57,942	82
					228,021	98
" Provident Fund :						
1. Contributions :						
(a) Senior Staff			8,728	25		
(b) Junior Staff			1,201	49	9,929	74
2. Administration Expenses					75	00
					10,004	74
Carried forward					\$306,732	10

INCOME.

By Contributions received :	\$	c.	\$	c.	\$	c.
F.M.S. Government, January-November			381,685	12		
Johore Government, January-December			50,000	00		
Kelantan Government, January-September			9,305	25		
Kedah Government, January-November			40,582	13		
Trengganu Government, January-September			2,649	43	484,221	93
"						
Contributions due and not yet received :						
F.M.S. Government, December (estimated)			30,000	00		
Kedah Government, December (estimated)			5,760	00		
Kelantan Government, 4th Quarter			2,783	63		
Trengganu Government, 4th Quarter (estimated)			500	00	39,043	63
"						
Contributions due and received since :					71,232	09
S.S. Government						
" Miscellaneous Receipts :						
Bank Interest			2,467	23		
Sales of Rubber, etc.			1,836	93		
House Rentals			6,185	89	10,490	05
"						
Publications : Sale Proceeds :						
Manuals			552	44		
Bulletins			61	17		
Annual Reports			281	16		
Quarterlies			756	09	1,650	86
Carried forward					\$606,638	47

Dr. INCOME AND EXPENDITURE ACCOUNT FOR YEAR ENDED 31st DECEMBER, 1930.—(cont.) Cr.

EXPENDITURE—(cont.)				INCOME—(cont.)			
	\$	c.	\$	c.	\$	c.	\$
To Reserves for:							
(a) Staff Leave Pay	...	...	30,958	00			
(b) Staff Passages	...	...	11,878	00			
Depreciation	...	...			58,823	83	
Staff Recruiting Expenses	...	...			4,347	47	
Medical and Hospital Charges	...	...			1,384	50	
Dental Treatments	...	...			305	00	
Travelling Expenses of Staff:							
(a) Within British Malaya	...	...	13,148	80			
(b) Beyond British Malaya	...	...	1,579	18			
General Office Charges:					14,727	98	
Printing and Stationery	...	...	1,690	95			
Postages and Telegrams	...	...	708	82			
Telephone Subscription and T'calls	...	...	1,901	14			
Audit Fees	...	...	1,000	00			
Legal Fees	...	...	75	00			
General Expenses	...	...	600	07	5,975	98	
Rents, Rates and Insurance	...	...			4,972	58	
Laboratory General Charges	...	...			2,000	18	
Upkeep Buildings:							
Residential Houses	...	...	5,857	47			
Laboratory Buildings	...	...	3,428	55	9,286	02	
Upkeep Laboratory Grounds	...	...			775	59	
Upkeep Furniture	...	...			1,704	25	
							606,638 47
					Brought forward	...	

To Plant and Machinery:					
Upkeep and Repairs	...	1,125 48	...	...	7,686 94
Running Expenses	...	6,561 46	...	...	
" Lorry:					
Repairs and Upkeep	...	255 88	...	...	1,457 25
Running Expenses	...	1,201 37	...	...	28 48
" Upkeep Workshop	...		...	...	8,716 94
" Laboratory Apparatus and Glassware re-	...		...	...	4,790 82
placement and upkeep of	...		...	...	
" Laboratory Chemicals	...		...	...	
" Publications:					
(a) Printing:					
Quarterly Journal	...	6,365 09	...	...	
Annual Reports 1929	...	1,865 81	...	...	
Sundry Publications	...	2,503 48	...	...	
(b) Distribution Expenses	...	1,174 00	...	...	11,908 38
" Library:					
Purchase of Books	...	2,705 13	...	...	
Subscriptions to Periodicals	...	2,309 02	...	...	
Subscriptions to Newspapers	...	152 22	...	...	
Sundry Expenses	...	1,973 96	...	...	7,140 33
" Film Propaganda	...		...	...	722 96
" Field Experiments	...		...	...	9,088 72
" Interest on F.M.S. Government Loan	...		...	...	4,500 00
" Contingencies	...		...	...	412 01
" Exhibitions, Shows, etc.	...		...	...	2,504 18
" Balance Excess of Income over Expenditure	...		...	...	512,828 49
carried to Balance Sheet	...		...	...	93,809 98
					\$606,638 47

(Sgd.) V. LOUIS CACHEMAILLE,

Secretary.

15th January, 1931

\$606,638 47

BALANCE SHEET AS AT 31st DECEMBER, 1930—(cont.)

LIABILITIES (cont.)			ASSETS—(cont.)		
\$	c.	\$	\$	c.	\$
Brought forward ...		1,332,352 78	Brought forward ...		5,465 72
			General Machinery:		
			As per last Balance Sheet	22,214 86	
			Add Additions during year	1,625 00	498,466 37
			Less Depreciation for year	23,839 86	
				3,575 98	20,263 88
					25,729 60
			FURNITURE:		
			1. Residential Houses:		
			As per last Balance Sheet	37,754 05	
			Less sold during year ...	155 02	
			Less Depreciation during year	37,599 03	
				2,819 93	34,779 10
			2. Office:		
			As per last Balance Sheet	12,621 32	
			Add Additions during year	58 50	
			Less Depreciation for year	12,679 82	
				951 00	11,728 82
			3. Laboratory:		
			As per last Balance Sheet	1,110 68	
			Add Additions during year	896 75	
			Less Depreciation for year	2,007 43	
				150 57	1,856 86

4. Store:				
As per last Balance Sheet	...	230 14		
Less Depreciation for year	...	17 26		212 88
5. Library:				
As per last Balance Sheet	...	594 41		
Add Additions during year	...	139 56		
		<u>733 97</u>		
Less Depreciation for year	...	55 11		678 86
				<u>49,256 52</u>
LABORATORY EQUIPMENT AND APPARATUS:				
As per last Balance Sheet	...	55,975 48		
Add Additions during year	...	17,587 88		
		<u>73,563 36</u>		
Less Depreciation for year	...	14,712 67		58,850 69
LIBRARY BOOKS:				
As per last Balance Sheet	...	...	1 00	
Add Purchased during year	...	...	896 47	
			<u>897 47</u>	
Less written off during year	...	...	896 47	1 00
MOTOR LORRY:				
As per last Balance Sheet	...	...	891 11	
Less Depreciation for year	...	...	222 78	668 33
R.R.I. EXPERIMENT STATION:				
Capital Expenditure to-date	...	...		471,840 89
WORKSHOP EQUIPMENT:				
As per last Balance Sheet	...	...	1,347 59	
Less Depreciation for year	...	...	202 14	1,145 45
Carried forward ...				
			Carried forward ...	<u>\$1,105,958 85</u>

\$1,332,352 78

BALANCE SHEET AS AT 31st DECEMBER, 1930—(cont.)

LIABILITIES—(cont.)				ASSETS—(cont.)			
\$	c.	\$	c.	\$	c.	\$	c.
Brought forward ...			1,332,352 78				1,105,958 85
STOCKS IN HAND:				Brought forward ...			
Petrol and Oil				...		101 61	
Empty Petrol tins and gas cylinder				...		69 00	
Stationery				...		721 56	
Sundry Materials				...		354 26	
PAYMENTS IN ADVANCE:							1,246 43
Against Survey fees, travelling expenses, etc.							
							1,864 75
SUNDY DEPOSITS:							
Against Water Supplies, Telephone, etc.							250 00
ADVANCES TO STAFF FOR MOTOR CARS, ETC:							
Senior Staff				...		4,876 69	
Junior Staff				...		595 00	
							5,471 69
SUNDY DEBTORS:							
F.M.S. Government				...		30,000 00	
S.S. Government				...		71,232 00	
Kedah Government				...		5,760 00	
Kelantan Government				...		2,783 63	
Trengganu Government				...		500 00	
							110,275 63
At Experiment Station				...		2,876 84	
Sale of Publications				...		121 05	
Sundry other Debtors				...		1,588 15	
							114,861 67

FIXED DEPOSITS:

Mercantile Bank, Kuala Lumpur	...	20,000 00	
Chartered Bank, Kuala Lumpur	...	50,000 00	70,000 00
Staff Leave Pay Reserve.			
Staff Passages Reserve.			
Depreciation Reserve.			

CASH AT BANK AND IN HAND:

Rubber Growers' Association, London	...	600 16	
Chartered Bank, Ltd., London	...	2,409 71	
Chartered Bank Ltd., Kuala Lumpur:			
Board's Account	...	10,974 40	
Working Account	...	2,939 89	
Experiment Station	...	18 82	
		13,933 11	

Carried forward ... \$1,332,352 78Carried forward ... 16,942 98 1,299,653 39

